What's in This Issue

How to secure lower costs without cutting quality—that is always a neat problem to solve. Curtiss-Wright did it in its Curtiss Propeller Division in the mass **production of feathering propellers.** P. H. Scheck tells you all about it on page 1081.

Sintered carbide tipped tools are being used successfully for cutting **operations on valve parts** and fittings. John C. Coonley and J. H. Howieson, of the Walworth Company, describe this work on page 1085.

Precision grinding a **46-ft. diameter "horse-shoe"** is a big job for any shop to tackle. Westinghouse did it in producing the 200-in. Mt. Palomar telescope. Turn to page 1086 for the details and pictures.

Allis-Chalmers might be said to be a proponent of propane, because it is using propane gas **to heat-treat tractor parts.** In fact, the heat-treating department is new from one end to the other, including all equipment. Harold J. Stein, research engineer, and Edward J. Foley, metallurgist, on the Allis-Chalmers staff bring you on page 1090 the story of how tractor parts are heat-treated.

Machining **a mile and three-quarters** of slots in ring rails sounds like a tough job. One company has done it ingeniously. Better take a look on page 1098 and learn how.

Edward J. Foley

John C. Coonley

J. H. Howieson

Harold J. Stein

How much do you know about the working of **wrought coppers and brasses?** Would you like to have a guide? In a special 12-page section we tell you the latest information on "the brasses," with their characteristics, applications and common methods of fabrication conveniently summarized. The section begins on page 1101.

Progressive **drawing operations** can be simplified. John J. McHenry tells you the "trick" of doing this on page 1088.

If you use typical coppers and copper-zinc alloys, a list of **the various applications** is published on page 1107. Never before has this been available in such convenient form.

Inverted dies is a subject that most people know little about. C. W. Hinman describes the construction principles involved in the tenth installment of his series on the "Press Working of Metals" on page 1094.

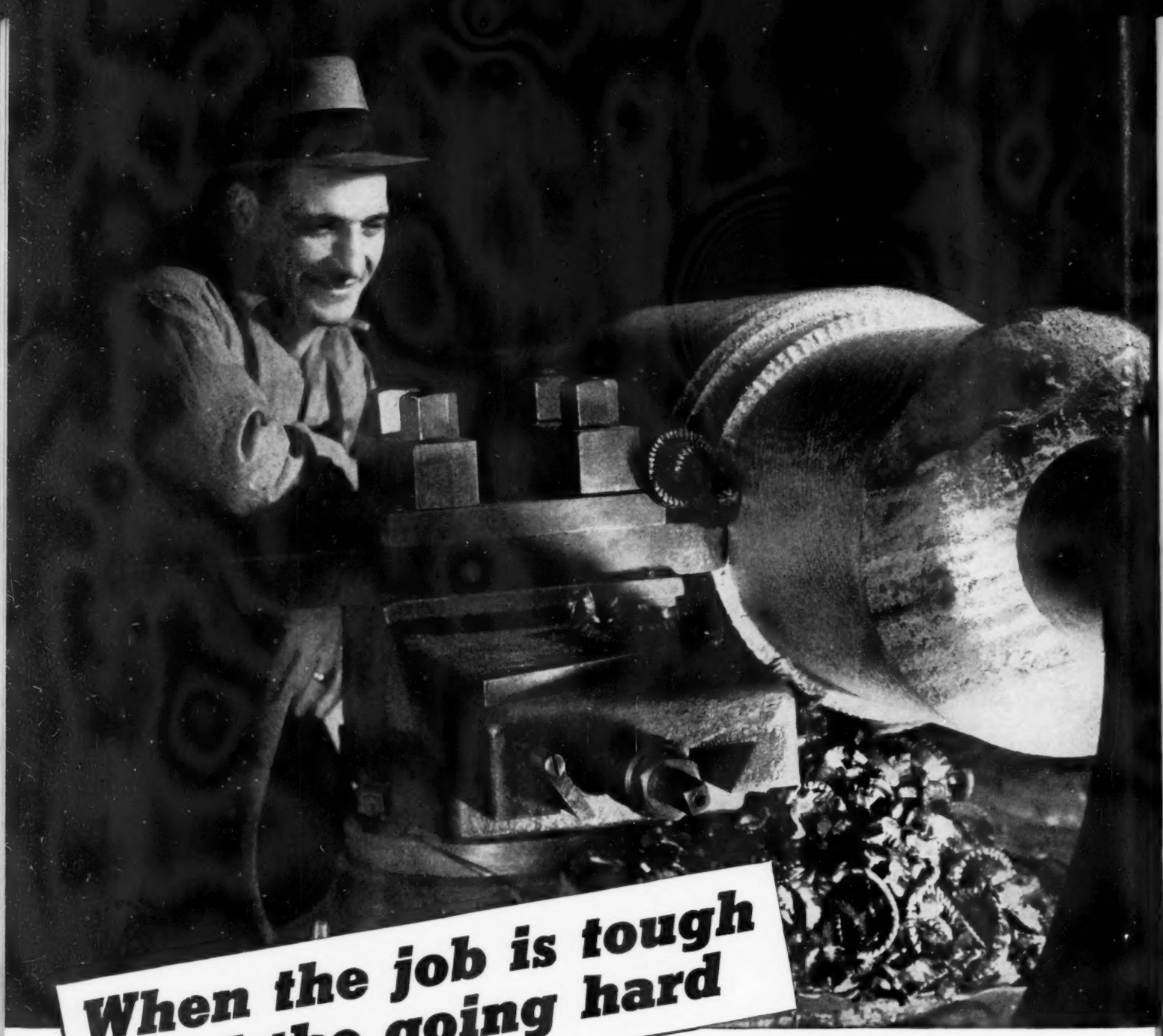
If widely adopted, the new **Chrysler transmission** will revolutionize the method of driving automobiles. Look on page 1112c for a description of this development and for interpretation of its significance.

COMING

The projection of cams, gears, screw threads and other machine elements has long been accepted as a useful means of inspection; but correct use of the method involves a good deal more than simply magnifying the objects on a screen. Such considerations as focusing, source of light, measuring methods and lenses must be examined to gain a good idea of the advantages and limitations of projection. They will be discussed in these pages by F. Loewen, of Carl Zeiss, Inc.

For operating its retractable airplane landing gear, Glen L. Martin uses two drums having cable tracks with a steep increase in diameter. Standard equipment and conventional methods did not quite solve the problem so this concern's tool designers got busy. A description of their ingenious solution will appear in an early number.

Of the prize-winning articles stimulated by the James F. Lincoln Arc Welding Foundation, that by John H. Hruska is of especial interest in the railroad field. The author, who is metallurgical engineer for the Electro-Motive Corporation, tells of the application of welding to diesel-electric locomotives. Special attention is given the increased safety factors attained and the economies of construction. An abstract of Mr. Hruska's story will be included in a forthcoming number of *American Machinist.*



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AMERICAN MACHINIST

ESTABLISHED 1877

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BURNHAM FINNEY, Editor

Why Casper?

H. T. WEBSTER's Casper Milquetoast comes to mind when we think of the stockholder in industry today. After labor, the government and all other agencies concerned have "got theirs," Mr. Stockholder hesitatingly comes forward and apologetically says in a low voice, "Please, if there is anything left, and you haven't anything else to do with it, I should like a small share. Of course, all I have done for your business is to furnish the capital."

Mr. Stockholder has feared that if he spoke louder than a whisper, the public would slap down his ears. Fortunately, the public's attitude toward him is changing as the part which he plays in our industrial set-up is becoming better understood. No better example is available than the data uncovered at Toledo to indicate his indispensable place in industry.

Ernst & Ernst have just finished a study of eight large Toledo industries operating in several fields and able to furnish comparable information over a period of years. These industries showed an average investment last year of $4,219 in machinery, plants and equipment for each employee. In some industries the investment was as high as $27,480 per employee. This is one of the reasons why industries have stockholders. Not many individuals would be able to own outright the larger industries. Ownership must be spread out among many investors.

The eight Toledo industries had 34,870 employees on their payrolls in 1937 and 30,782 stockholders. Thus the ownership of Toledo industry is almost as widely diffused as the number of jobs afforded. That ratio might roughly be applied to any of the larger corporations. Only the smaller businesses and industries are closely held or owned by a few stockholders.

By greater diffusion of ownership the average investment per stockholder in these Toledo industries dropped from $6,507 in 1929 to $4,780 in 1937. The average annual wage per employee last year was $1,521. If that figure is used, and it is assumed that a workman could save 10 percent of his wages for investment (which he probably can't), it would take him over 27 years to accumulate the investment requirement for this job. That fact illustrates graphically why stockholders are needed in industry.

If private industry is to continue in this country, certain elements are necessary to its existence. The loss of any one of those elements spells disaster. First of all, there must be a fully-equipped factory with modern machinery capable of producing goods at prices low enough that prospective customers will place orders. There must be workmen ready to give an honest day's work for an honest day's pay. There must be a sales organization capable of securing business in competition with other firms making the same products. There must be a management able to operate the company efficiently.

THE FIRST requisites, therefore, are a factory and equipment, employees to provide the manpower, and adequate working capital. To insure these essentials stockholders must provide the cash. Without them our economic machine couldn't run, because it wouldn't have any fuel.

It would be well to keep these facts in mind when someone says that stockholders are a necessary evil. After all, it is their willingness to take the risks involved in investing their money that makes American industry possible.

Gaging Business

ALTHOUGH machinery buyers are inclined to wait until after the year-end to place pending business, the metal-working industry in general shows signs of strong resistance to seasonal factors which normally drag it down as the holidays approach. Equipment purchases are reported to be light in almost all sections of the country, though here and there foreign bookings continue to bolster weak domestic orderbooks. Buying on the part of the federal government and by companies with large government contracts is fairly active. Steel output is holding up well this month, mills anticipating heavy tonnage releases in January.

December automobile assemblies are estimated at 420,000 units; January car production promises to be 380,000 units, or about 150,000 more than in the same month of 1938. Shipbuilding yards are swinging as rapidly as possible into huge program of navy construction work which will keep them occupied for several years.

NEW ENGLAND—Purchases by the government and companies with large federal contracts continue to dominate machinery buying. Demand for precision instruments is better. Some railroad shops have reopened after a six months' shutdown. Government-financed building construction is active.

NEW YORK—Machinery sales are less in volume, with considerable buying deferred until after the turn of the year. Foreign orders for equipment have been lighter. Several large purchases of forging machines have been made for delivery abroad.

PHILADELPHIA—Machine tool dealers say that November was the best month of the year both in sales and inquiries. December will show a decline from last month's volume.

PITTSBURGH—Despite a slight downturn in steel operations, industrial production has reached a new high level for the year. It has risen continuously since June. Ohio River shipments of steel and other products have been the heaviest in 14 months. A local manufacturer has bought machine tools at a cost of $160,000, and expects to buy more. Machinery orders, however, are slow and no pick-up is anticipated immediately.

CINCINNATI — Machine tool orders are light this month. The total is likely to be less than in November. General Motors plants at Dayton are doing well. Frigidaire is building up a stock of new models for early Spring. Tool and die business in Dayton has receded.

CLEVELAND—Auto parts factories are fairly busy, but machine tool operations have dropped off a bit. Steel production is holding at a relatively high point. Foreign inquiries for machinery continue active.

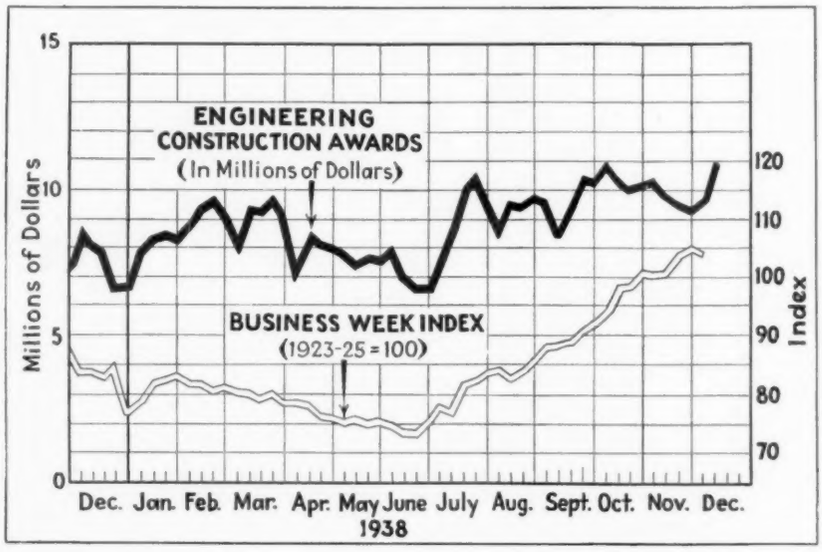
DETROIT—Sales of special equipment, such as injection molding presses and hydraulic metal forming presses, are up. Ford alone is reported to have placed a $200,000 order for hydraulic presses. Local stove companies have not had much of a fall sales season and are working only two or three days a week. Kelvinator is running five days a week. Toledo's employment, at 18,939 for 51 selected plants, has touched a new high for the year.

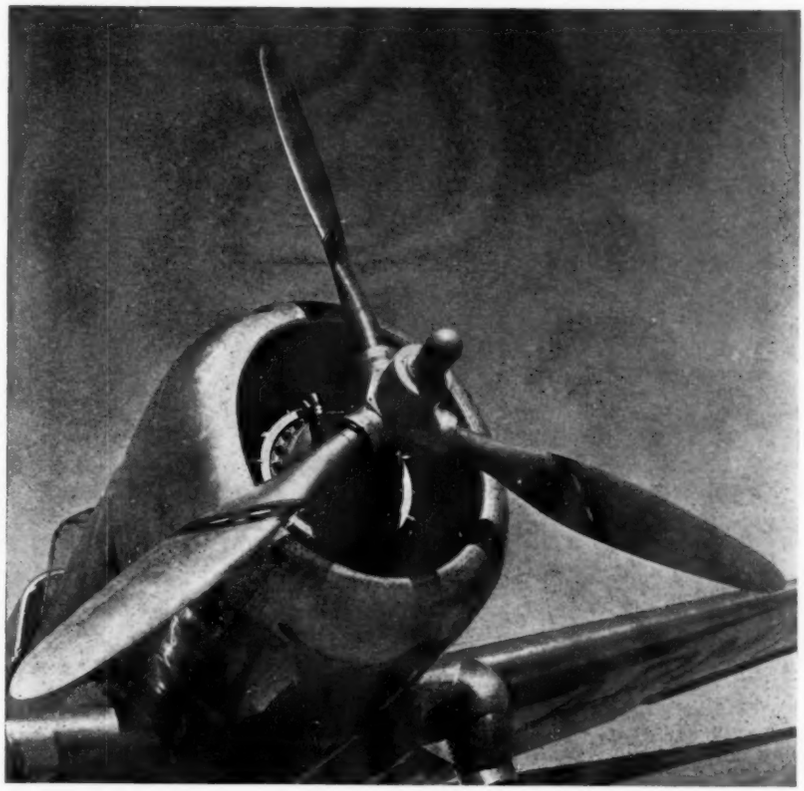
CHICAGO — Industrial operations have tapered slightly. Steel output is staying near 60% supported by automotive buying. Tonnage from farm implement and tractor companies is fair. Orders for railroad cars have improved. Electro-Motive Corp. will supply nine diesel switch engines to the Jersey Central and Reading. Commonwealth Edison has plans for spending $8,000,000 in next two years to expand its capacity. Small tool orders have dropped sharply. Machine tool business is off, with customers likely to postpone much buying until after the year-end. Machinery plants report operations on the down side.

SAN FRANCISCO—Business indices show improvements contrary to the normal seasonal decline. Machine tool orders, somewhat better, are still not good. Preliminary reports indicate a revival in the lumber business. Airplane plants show a falling off of 10–20% in payrolls, but production is close to the 1937 peak, with orders to hold current rate for the next year.

CONSTRUCTION AWARDS VS. GENERAL BUSINESS

The steady, if unspectacular, upward trend of engineering construction awards is of special interest to the metal-working industry, providing as it does an indication of future construction activity





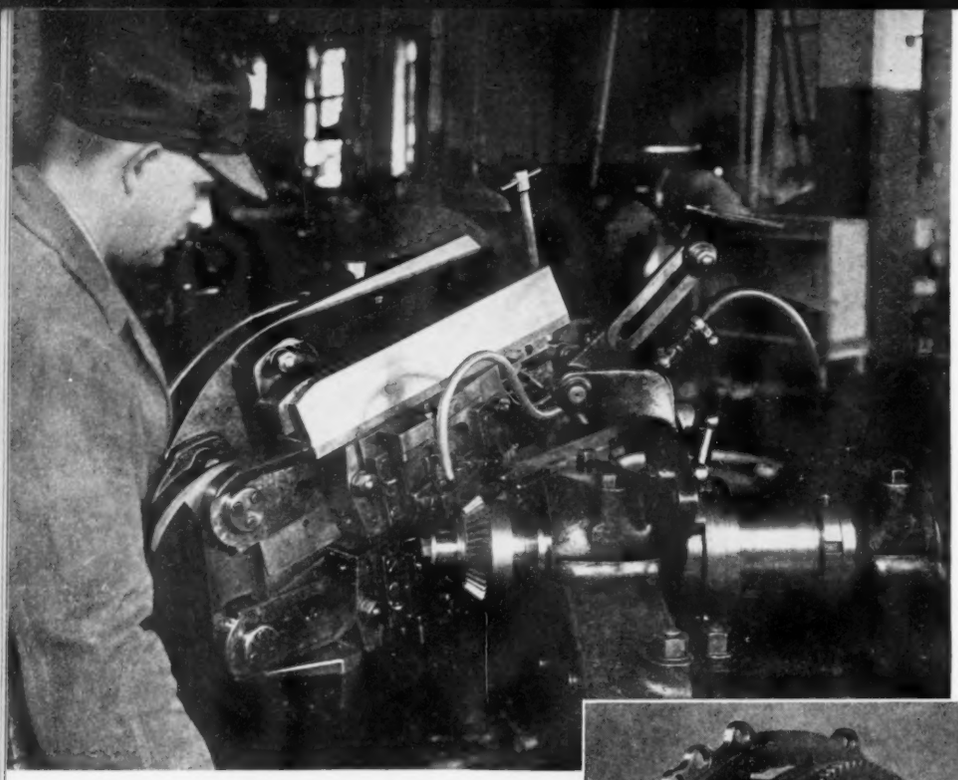
Geared to the Skyways

Curtiss propellers are feathered for constant speed by means of gears which furnish a nice problem of precision manufacture

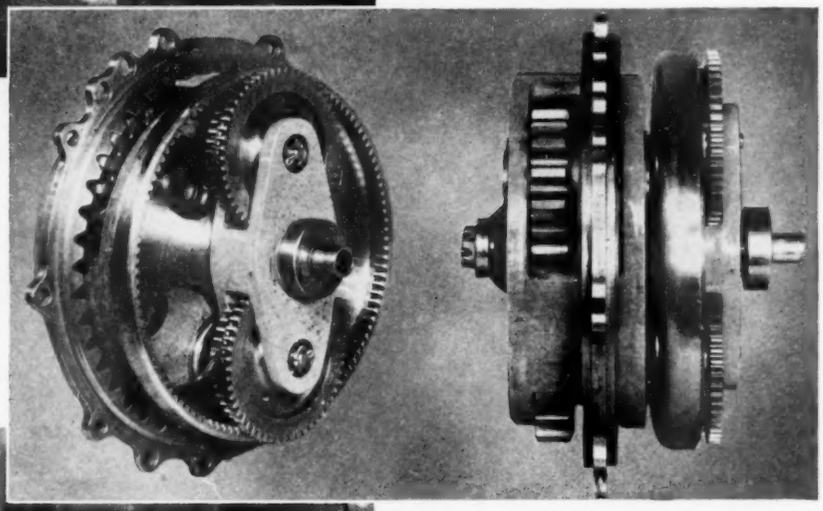
P. H. SCHECK
Curtiss Propeller Division, Curtiss-Wright Corporation

BECAUSE of increased demand for constant-speed propellers capable of being feathered, the Curtiss Propeller Division of the Curtiss-Wright Corporation has rapidly expanded its production facilites and adopted new manufacturing processes which permit larger production volume. The selection of new processes in the manufacture of such vitally important equipment is a problem which must be attacked from a different angle than a simple desire to attain mass production by cutting corners. The nature of the work which must be performed by the propeller and the dependence placed upon its successful operation demand that every part used in its fabrication be made to precise standards and of the best available materials. The compromise choice of inferior materials because of ease of machining, practiced in less exacting industries, is not permissible. Reduction of standards of workmanship and extensive increase in dimensional tolerances are likewise not acceptable means of speeding up production. The only course remaining open to the manufacturer of propellers by which a larger volume of production may be attained is that of facing the difficult problems presented and developing processes to achieve the desired production without sacrificing quality.

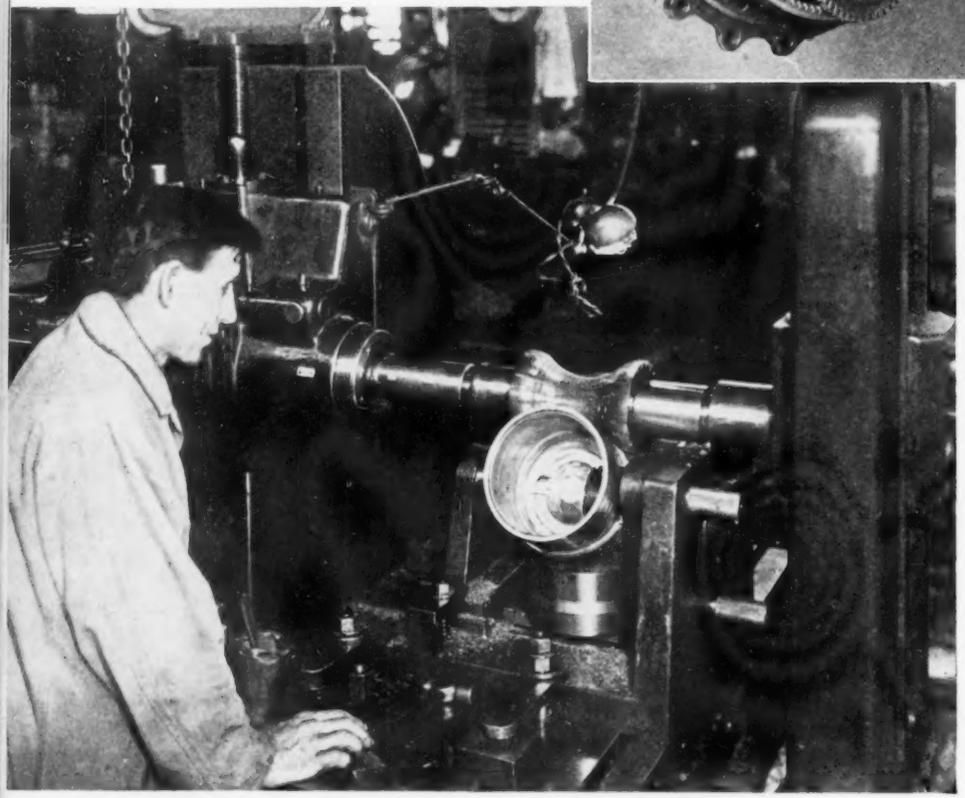
One of the more acute manufacturing problems encountered in the process of placing the propeller on a production basis was the development of a satisfactory method of fabricating gears of high tensile strength and tooth hardness. Blade adjustment of the propeller is controlled by a single bevel drive gear which meshes with three blade gears, each mounted at the base of its respective blade. As a result of limitations imposed by the requirements of balancing, it is not



Skilled operators are employed to operate the gear shapers on which bevel gear teeth are machined after heat-treatment. Constant care insures against wear or springing of the tools, which would adversely affect the quality of the product



Parts for the speed reducer of the pitch changing mechanism are held to close dimensional tolerance. All gears are heat-treated before machining. Smooth operation of this unit is of prime importance



A number of rough and finish machining operations are necessary on the forged hub. These are interspersed by frequent wet Magnaflux tests to avoid unnecessary waste should there be a defect

possible to permit individual shimming of the blade gears to correct for uneven meshing, and as a consequence, the dimensional limits which must be maintained are extremely close. Because of the extremely heavy tooth loading combined with engine vibration, it is necessary to make the gears of a tough alloy steel and heat-treat them to a high degree of hardness for resistance to wear.

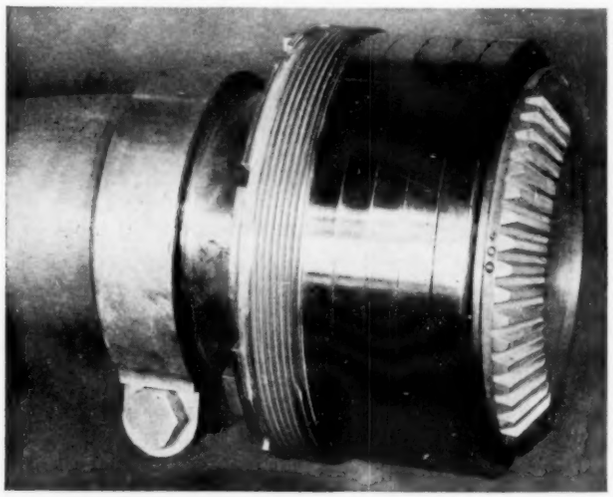
The problems either of obtaining the proper hardness or of attaining the desired dimensional accuracy do not separately present serious difficulty, but the routine adherence to such a high standard of accuracy on gears heat-treated to a tensile strength of 180,000 lb. per sq. in. is a problem worthy of the metal of any production organization. On an experimental basis it would be possible to meet these requirements by heat-treatment after machining, using a coating of copper plate to prevent excessive warpage, but the scrap loss would be too high for production purposes. The only course left open to the manufacturer is that of facing the necessity of machining the bevel gear after heat-treatment, an appalling prospect even to experienced bevel gear makers.

After thorough study of the problem and exhaustive experimentation, the blade and drive gears were fabricated from chrome-nickel steel, forged to shape on a drop hammer and heat-treated before finish machining. The development of tools to machine this hard gear on a production basis was successfully completed and the gears now are in mass production.

Because of the elimination of joints and attaching parts it was decided that weight could be saved by making the hub a single self-sustaining part forming the backbone of the assembled propeller. This hub is made

from a drop forging of chrome-nickel-moly steel, a material which has been found to be the most satisfactory for this type of equipment by the U. S. Army Air Corps and the Navy Bureau of Aeronautics. This material is exceptionally tough to machine and satisfactory forgings may be made only by experienced personnel employing the finest equipment. To outward appearances this forging is simply a piece of metal formed to a certain irregular shape, but the art of producing such a forging is fully as scientific as the fine machine work which must be performed upon it before it is brought to the completed state.

Primarily, to assure uniform strength in all three hub sockets and to guard against fatigue failure, the forging process must be worked out with mathematical precision so that the grain flow of the metal follows a certain regular pattern. To check these manufacturing processes, test hub forgings must be split along various axes and acid etched so that the grain flow pattern becomes visible. A photograph of a cross section of a hub after etching is shown. The pattern of grain flow must be such that the fibers along the outer perimeter of each hub socket are placed in tension by the centrifugal loads imposed by the blades.



This shank assembly of a Curtiss propeller blade has a matched stack of angular thrust bearings in place. The four outer bearings divide the centrifugal load equally

High-Quality Forgings

In addition to having the proper grainflow, the hub must be entirely free of all inclusions, cracks, or cold shuts. This requirement makes it imperative that the forging operations be carried on at exactly the correct temperatures and that the technique of drawing down the metal be carefully planned and followed through. After forging, the hub is rough machined to remove scale, and the wet Magnaflux method is used to locate cracks or inclusions. This test is conducted early in the machining process to avoid unnecessary waste should a serious crack be discovered. The Magnaflux method of checking is used again at various intervals during the machining process and the final check is made after all of the machine work is completed. At any time during the machining operations, a crack or inclusion which cannot be removed without making the hub undersized is cause for complete scrappage of the part.

Magnaflux Testing

For the uninitiated it might be timely to explain at this point that the wet Magnaflux test consists of magnetizing the part to be tested and submerging it in a bath of oil containing powdered iron oxide. Any crack or inclusion in the material changes the polarity of the point at which it exists and causes the iron oxide to cling at that point, thus locating the defect. All steel structural parts of Curtiss propellers are Magnaflux tested.

After the hub has passed successfully through the first Magnaflux test, the rough machining and then the finish machining operations are performed. One of the more interesting of these machining operations is shown. Here a form cutter is being used to rough machine the section between the hub sockets. This photograph shows the hub sockets rough machined ready for the grinding operation. The material being machined is heat-treated to a tensile strength of 135,000 lb. per sq. in. prior to machining and care must be taken to provide durable tools to withstand the hard service encountered during milling. The internal surfaces of the sockets later must be ground smooth to a precise tolerance so as to accommodate the precision angular-contact bearings which are used to retain the blades. Other operations worthy of mention are the thread milling operation on the threads at the top of each socket and the grinding of the cone-seats. Upon completion of the machining process and the final Magnaflux test, the hub is thoroughly inspected by a highly-skilled mechanic equipped with precision gages and instruments.

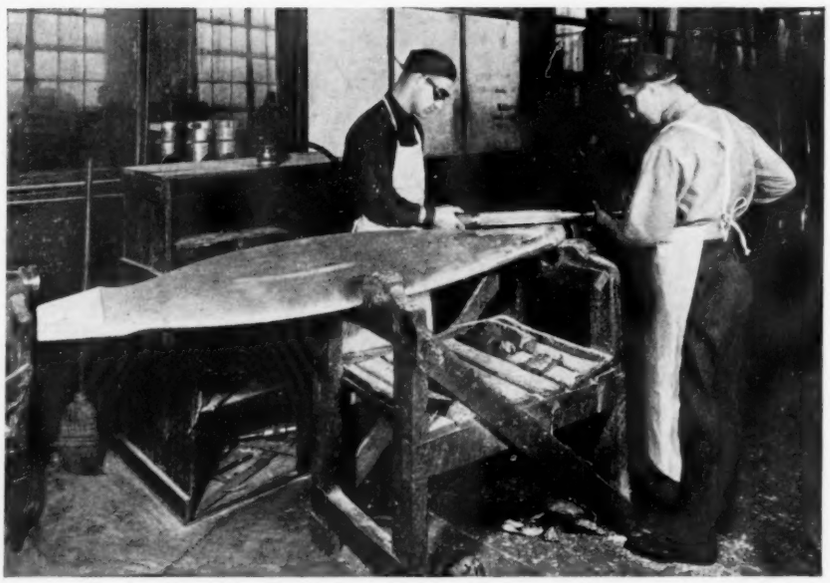
The reduction gears of the speed reducer which transmit the power from the pitch changing motor to the propeller blades are also machined after heat-treating and must be held to close dimensional tolerances. The gear train, all gears of which are mounted on precision ball bearings, is shown. Fine alignment and accurate finishing must be accomplished on each individual part of this train to allow smooth operation and to reduce friction to a minimum. The heavily-stressed gears must be case hardened to provide resistance to wear and the driving gear on the low-speed output end of the speed reduced is made from a special steel because of the ability of the selected material to resist wear and abrasion. The careful selection of the proper steel for each part by the engineer must in each case be supplemented by a careful study of the manufacturing problems by an experienced manufacturing department so that the advantage gained by improvement in quality may be made available to the consumer without undue increase in cost.

Bearings are Stocked

Prominent in the development of improved aircraft accessories are the bearing manufacturers. When the blade retention for the Curtiss propeller was under consideration it was largely through the advanced skill of these manufacturers that the arrangement finally decided upon was made possible. The development of the angular contact ball bearing stack made possible the use of a smaller hub socket than that which had previously been considered necessary as the result of using a single large thrust bearing. The angular contact type of bearing, used in stacks, would not have been permissible had it not been for the extremely high degree of accuracy attained in the manufacture of these bearings. The four outboard bearings carry the load imposed by centrifugal forces from the blade. The innermost bearing is reversed to carry the load imposed by the preloading of the outer bearings. It is possible for the four outer bearings to equally di-

vide the centrifugal load between them since they are so accurately ground that the bottom bearing absorbs its share of the load, and, in so doing, deflects sufficiently to transfer the remainder of the load to the next bearing and so on. The bearings operating in this manner may be built to a smaller outside diameter and consequently require a smaller diameter hub-socket to retain them.

With bearings manufactured to such close tolerances must be maintained to achieve the results outlined, extremely close tolerances must be maintained in the machining of the hub sockets and the blade shank retainer surface. The use of carefully designed fixtures has made possible the necessary precision now being maintained on a production basis. Blade manufacturing methods are of prime importance and interest because a propeller blade is of such irregular shape that it cannot be machined on any orthodox metal shaping machinery. Like the propeller hub, there are a number of specialized processes and tests which must be performed before the actual work of blade machining is started.



A portable pneumatic tool drives a special cutter to rough the shank fairing on each propeller blade. The tip of the blade later is rough machined, then the blade is sanded and balanced

High standards of workmanship are necessary throughout the machining and assembly operations in the production of Curtiss constant-speed feathering propellers. Each unit is carefully checked many times before final assembly and test

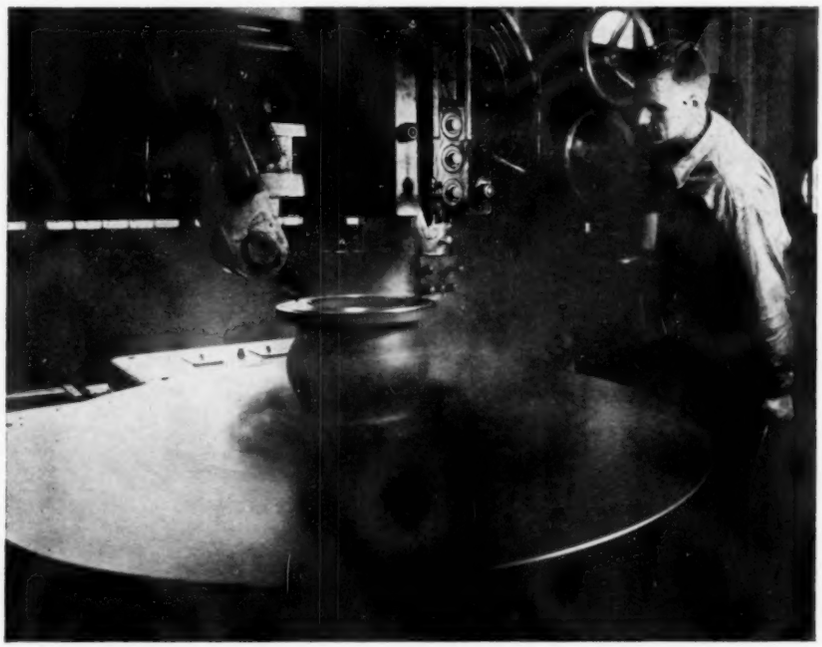
Forging of aluminum alloy blades is done on large drop forge hammers by men skilled in the art of working the metal down so that the grain flow is uniform and so that each section is worked equally under the dies. Careful temperature control must be exercised to prevent burning the thin sections of the forging or working the thicker sections at too low temperature. Each blade shank has a test coupon forged on its lower end upon which chemical and physical tests are conducted to determine the exact composition, strength and elongation of each individual blade. Upon acceptance of the blade forging, the tip end is centered and the blade is placed in a lathe for shank machining. The clamping surfaces and grooves of the shank must be finished accurately to insure the necessary fit inside the blade retaining sleeves. Special tooling and checking fixtures permit the required high standard of accuracy to be maintained on mass production quantities with little or no scrap.

After the planform has been roughed out, the blade is placed in a special profiling machine where the contour of each section of the blade is milled. Here a cam guides the cutting arm over the blade, duplicating the cam contour. As the cutter is moved along the blade the cam rotates, thus allowing the irregular contour of the blade surface to be machined to close limits without hand work. After the profiling work has been completed, all that remains is the rough machining of the tip and the shank fairing, and the smooth finishing and balancing of the blade. The shank fairing is roughed out by the use of a compressed air operated cutting tool. Smooth finishing is accomplished on a sanding machine. The table upon which the blade is clamped has a universally mounted head which allows the blade to be swung into any position so that all of its surface may be sanded by the continuous-belt type sanding machine.

After completion of the sanding operation the blades are carefully checked for trueness of angle and track and are balanced against a master blade. Upon completion of this initial balancing operation a buffing wheel is used to bring the blades to a high finish. Finally, as a final check, a balance check against the master blade is again made.

Sintered Carbide on Valve Materials

JOHN C. COONLEY, *Tool Superintendent and* J. H. HOWIESON, *Timestudy Manager, Walworth Company*



Facing the flange of a 12 in. wedge gate valve body made of tough carbon-molybdenum steel is expedited by the use of sintered carbide tools

SPECIAL materials, such as molybdenum steel, monel metal, bronze, brass and malleable iron, are frequently used in the manufacture of valves to withstand the high pressures, corrosive fluids and other life-destroying factors to which they are exposed. To obtain the high precision and fine finish required on these materials and at the same time to keep machining costs within proper limits, the Walworth Company has made a number of applications of sintered carbide tipped tools to cutting operations on valve parts and fittings.

An interesting operation is the seating, boring and back facing performed on a globe valve seat ring. These rings are made from 18 per cent chromium, 0.90 carbon steel which is heat-treated to a Brinell hardness of between 500 and 525. The seats must be cut to an 0.001 in. tolerance and have an accurate taper. For this operation, Firthite sintered carbide tools have improved the production and the quality of the cut finish. No grinding is necessary following the finished cut. These operations are performed on a Heald Borematic machine, using an emulsified coolant.

When applied to carbon-molybdenum steel castings used as valve bodies and pipe fittings of various sizes, sintered carbides made an excellent showing on boring mills for facing operations without the use of a coolant.

Monel metal, because of its toughness and work-hardening properties has always presented a problem from the standpoint of tool life. Here again sintered carbides seem to be the answer. The Walworth shop, using Warner & Swasey turret lathes, faces and turns monel metal yoke nuts within a tolerance of 0.002 in. For this work, surface speed was tripled, and tool life was increased from 2 to 60 pieces per grind over high speed steel tools.

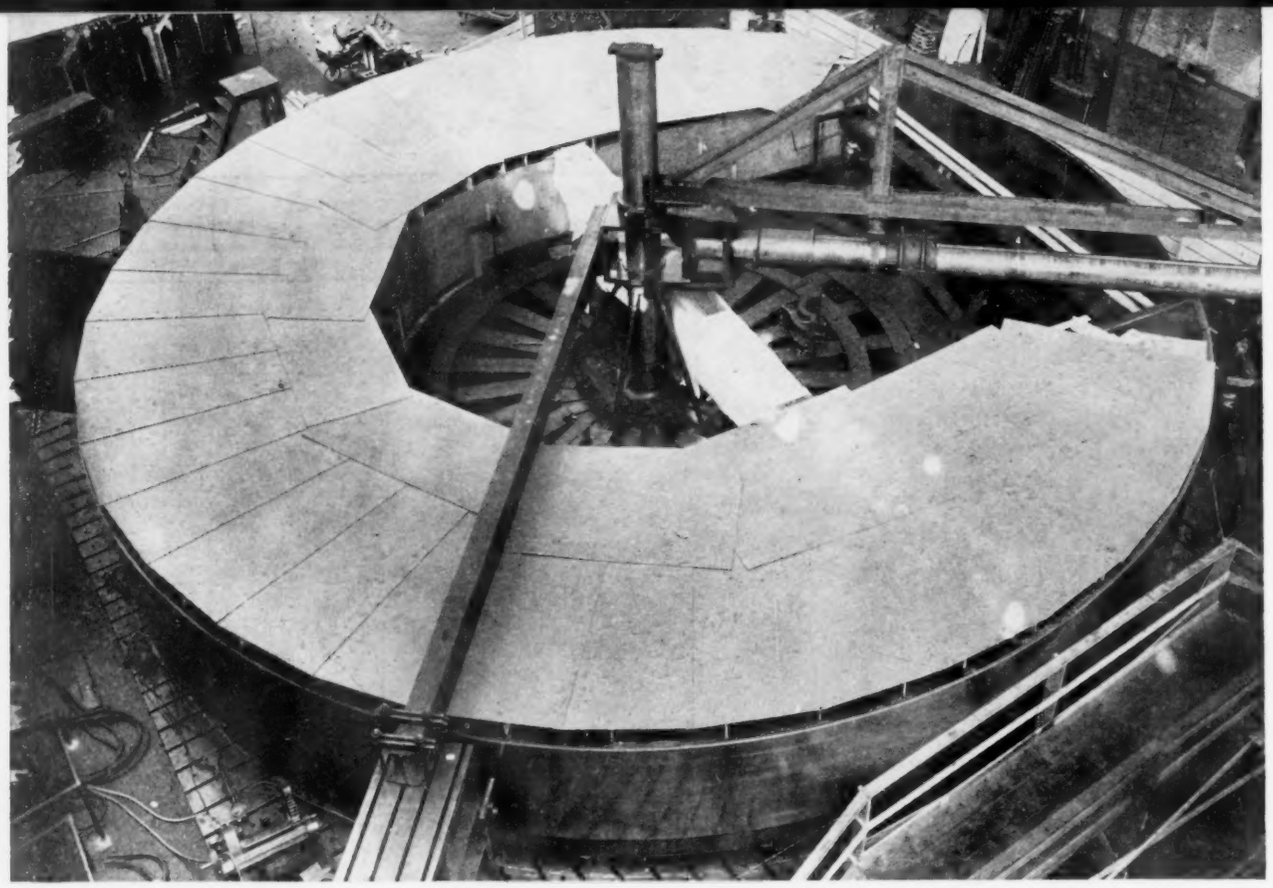
Bronze wedges of various sizes are used in the construction of high pressure bronze gate valves; these wedges require facing and turning. For this application, production efficiency showed considerable increase upon the application of sintered carbide tools, since both surface speed and production rate were increased. In some cases, stainless steel forgings are used for wedges and cutting operations on them showed a similar improvement.

In a large number of valves of different types, stainless steel bar stock having a 220 Brinell hardness is used in the production of valve stems and valve seats. Seats are machined and heat-treated for greater hardness after cutting. Satisfactory production has been obtained with the use of sintered carbide.

The Walworth Company has found it practical in the course of its operations to produce steel for its own consumption. This steel is cast in test bars approximately 2 in. square which are turned, unannealed, to a standard 0.505 in. A.S.T.M. bar and then tested in tension. Previous experience revealed that in this operation it was rarely possible to cut one bar per tool grind using an 0.008 in. feed per revolution with a cut ranging in depth from $\frac{1}{16}$ to $\frac{1}{2}$ in. However, upon the application of Firthite sintered carbon tools, it was found possible to turn 20 pieces per tool grind using the same feed and depth of cut. In all cases reported, carbide tools permitted an increase in speed of production and an increase in the number of pieces machined per tool resharpening.

Feeds and Speeds of Carbide Tools on Various Materials

Operation	Surface Speed, ft. per min.	Feed in.	Depth of Cut in.	Pieces per Tool Grind
Machining 500 Brinell 18 chrome 0.90 carbon steel	350	0.002	0.008 (2 cuts)	100
Facing carbon-molybdenum steel castings	100	0.032	1/8 to 1/4	25
Machining monel metal valve yokes	150	0.012	3/32	60
Facing and turning bronze gate valve wedges	700	0.004	1/32	1000
Turning and facing stainless gate valve wedges	80	0.012	3/16	50



The top of the "horse-shoe" was covered with a layer of wallboard to hold dimensional changes caused by temperature variations to a minimum. This covering was spaced about one foot above the top surface of the unit, in order to allow for circulation of air. In addition, the skylights above the mill were painted blue

Scratches on the ground surface were measured by an instrument employing the "shadow method" developed by the research laboratory. In this instrument, light shown under a quartz straight edge gave reflections which could be translated into depth. These scratches were found to be only a few ten-thousands of an inch in depth

Finished for the

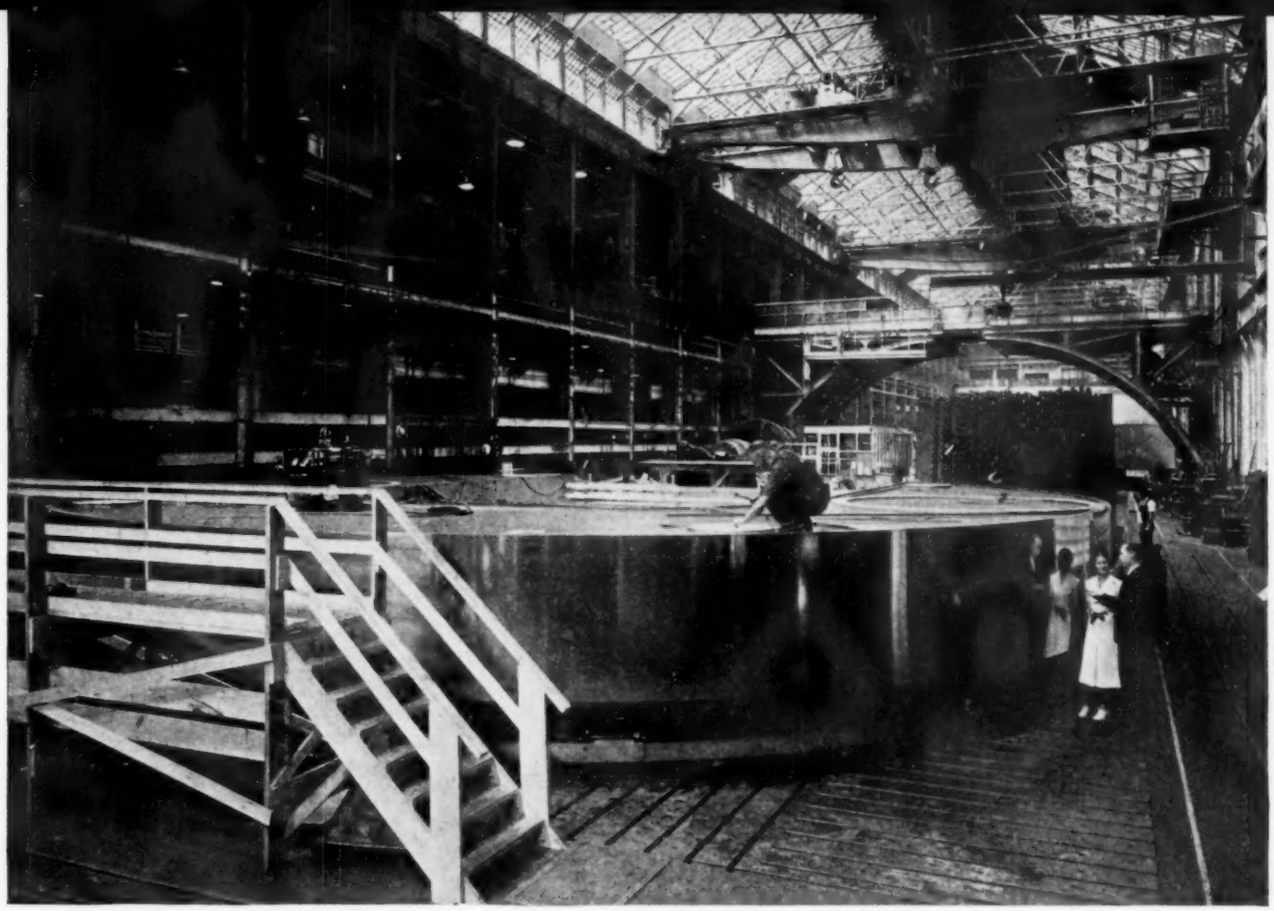
Temperature variations complicated the problem of finish grinding the 46-ft. diameter "horse-shoe" mounting unit for the 200-in. Mt. Palomar telescope

CONSTRUCTION of the parts for the 200-in. telescope to be erected on Mt. Palomar for use by the California Institute of Technology presented many difficult fabricating and machining problems, not the least of which was the finishing of the bearing surface on the circumference of the so-called "horse shoe." This member, composed of three parts—east horn, west horn, and center portion—is roughly 46 ft. in diameter, 4½ ft. thick and weighs about 315,000 lb.

A 20-Mile Cut

Machining and grinding operations on this part were performed on an especially arranged floor-level boring mill at the East Pittsburgh Works of the Westinghouse Electric & Manufacturing Company. The turning operations, which already have been described (*AM*—Vol. 82, page 460), were complicated since the cut, employing a fine feed, was between 20 and 30 miles long. Even special extra hard tools would break down long before the cut was completed. Once the turned finish was as good as it was possible to make it, with the best tools available, grinding and buffing operations were started.

Both rough and finish grinding operations were performed with a 15-hp. vertical grinding head which was mounted in the same set-up as was used for the previously described turning operation. For roughing, an Aloxite vitrified 18x3x2-in. wheel was used. Breaking down the surface with this grade 0, grit 30.S aluminum oxide wheel required considerable time since, comparatively speaking, the surface was rough and uneven.



Final polishing was done with a muslin buff wheel using the old stand-by "green stick." The finish obtained is indicated. It was straight across the face within less than 0.0015 in. and maximum out of round for the 36-ft. diameter was 0.002 in.

Heavens

D. B. CHARTERS
Manufacturing Engineer
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& Manufacturing Company

One pass across the surface, using a ½-in. feed and a 0.001 in. depth of cut, required about eight hours. Soda water was used as a coolant, and rubber scrapers were used to wipe the coolant from the surface and run it back into the coolant tank. This wheel cut well, the cuttings having the characteristics of broken-up steel wool.

Temperature Troubles

About the time that the surface had begun to assume the appearance of a ground surface, it was noted that the "horse shoe" was changing in size constantly. Some time about the middle of the morning, when the sun began to come through the skylight, the grinding cut would begin to get heavier, so much so that the operator had to withdraw the wheel gradually, keeping the depth of cut constant by continual vigilance. The first corrective step taken was to paint the skylights blue, but this was not sufficient.

The next step was to cover the top of the unit with builder's wallboard. This was spaced about one foot above the piece to allow for air circulation and improved grinding conditions considerably, but there still was enough movement to make the grinding operation a tedious and nerve-racking job. Readings taken to determine the time when movement was most negligible indicated that the most suitable time to grind was from about 2 a. m. to 8–9 a. m. The job was kept rotating constantly and most of the grinding was done during this period in order to keep inaccuracies caused by temperature changes to a minimum.

Finish Grinding

Finish grinding was performed with an Alundum 18x3x2 in., grit 3846, grade K, vitrified bond aluminum oxide wheel. The surface presented characteristic marks of grinding, having an apparently wavy surface emphasized by the large diameter, which approached the condition of a flat surface. There also were a large number of marks which had the appearance of scratches. The depth of these marks was measured by an instrument employing the "shadow method" and developed by the Westinghouse research laboratory. In this instrument, light shown under a quartz straight edge shows reflections at the low point of the scratch and these, measured for length, can be translated into depth. By this method the scratches were found to be but a few ten-thousandths of an inch deep.

Finish by Buffing

The third step in this finishing process was to mount another small vertical grinder carrying a "Quick-as-a-Wink" buffing wheel on the tool post. This wheel has a soft rubber rim on which an abrasive belt can be tightened. It was necessary to fence the job in at this time, as the shiny surface seemed to have all of the attraction of a "Wet Paint" sign. Practically everyone who passed the job felt impelled to rub his hand over the surface, which rusted immediately wherever it had been touched. Belts of 40, 60, 80 and 120 grit sizes were used in the order listed. Following this buffing operation, the surface was finished with a muslin buff wheel, using the old stand-by "green stick" for final touching up. Final checking showed the maximum out-of-round for the 46-ft. diameter of the finished job to be 0.002 in., while this surface was straight across the 53-in. face within less than 0.0015 in.

Shells from Strip

A seven-stage progressive die carries the stock through successive stages from the initial shear to the final draw and trim

JOHN J. McHENRY

SUCCESSIVE OPERATIONS for drawing shells from strip stock include seven steps as shown in the layout, Fig. 1, with the final operation giving a squarely trimmed shell having walls of uniform thickness.

In the die arrangement used here, the blank is not completely cut out of the strip until the last drawing operation. Being held by two curved fingers of strip steel the drawn shells may move freely, above, below and through the strip stock without change in center distances and without deformation of the material. The progressive compound die, shown in the bottoming position in Fig. 2, has notching, piercing, shearing, flattening, and draw punches on the bottom shoe, and the dies on the top shoe. The strip stock is moved along on a spring actuated stripper plate.

Operations are begun by inserting the strip through the space provided between guide *A* and stripper *X*, then between guide pins *B* against trigger *C*. When the press is tripped the ram actuates the stripper on the down stroke. As the ram recedes, the location notch is cut, and the blank is sheared through except where the blanking punch is ground away at *D*, as shown by the angle in Section *B-B*.

The trigger *C* is withdrawn by the pin *F*, and the tension spring *G* will pull the tripper over against the opposite side of the slot thus moving the trigger indexing end over $\frac{1}{32}$ in. The slug from the location notching punch *H* will move upward, and as sufficient slugs are made to fill the space through the die, they will go up and out through the curved opening shown in Section *B-B*.

Notches for Locating

On the upstroke of the ram, the stripper returns to position, shedder *E* forces the sheared blank back to the strip stock and trigger *C*, having moved $\frac{1}{32}$ in., returns to contact the strip stock edge immediately back of the starting end of the strip stock. (In the following operations, the trigger will contact the edge $\frac{1}{32}$ in. back of the location notch.)

The stock advances to the second station between and under the apex of the two guides *J* and stops when the trigger enters the location notch made at the first station. The sheared blank is pressed back in the strip stock at the second station between the die *K* and the flattening punch *L*.

At the third station the stock is sheared through as in the first station except that the angle on the blanking punch is ground on the opposite side, *M*. The blank is now cut free of the strip stock with the exception of the two "fingers" which did not cut through because of the angle on the blanking punches.

Die *K* and the flattening punch *N* press the blank back into the strip stock at the fourth station.

The strip stock advances to the fifth station between and under the guides *Q*. Here the first draw is made and the reduction of the blank causes the carrying fingers to move in with the reduced blank diameters. It is important that the draw punch *O* be high enough to draw a shell of suffi-

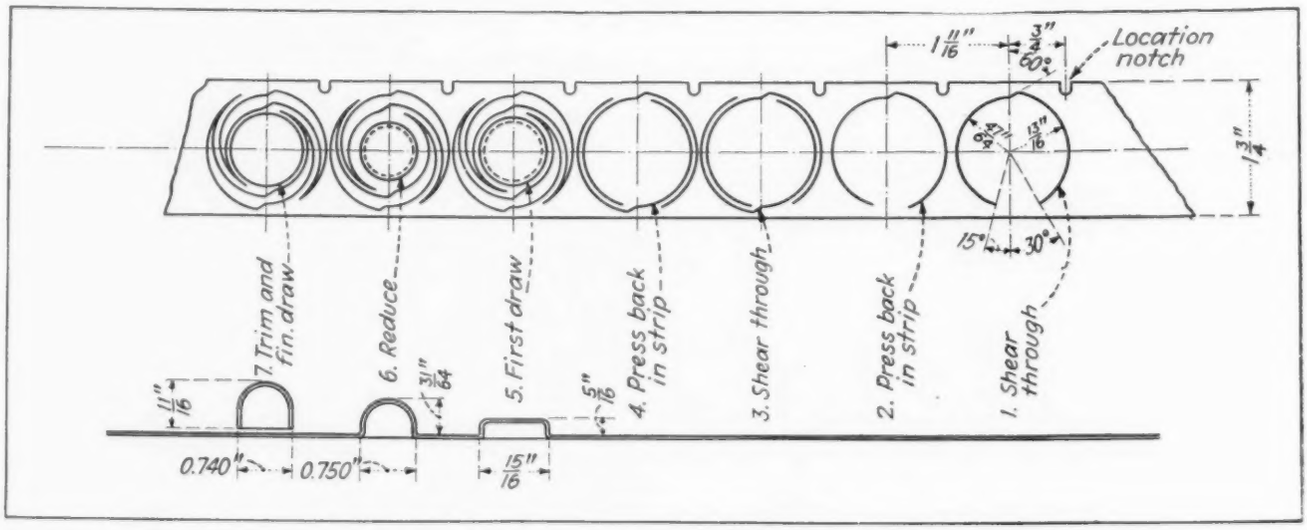


Fig. 1—A shell, drawn from No. 20 gage cold-rolled steel, is not separated from the strip until the last operation

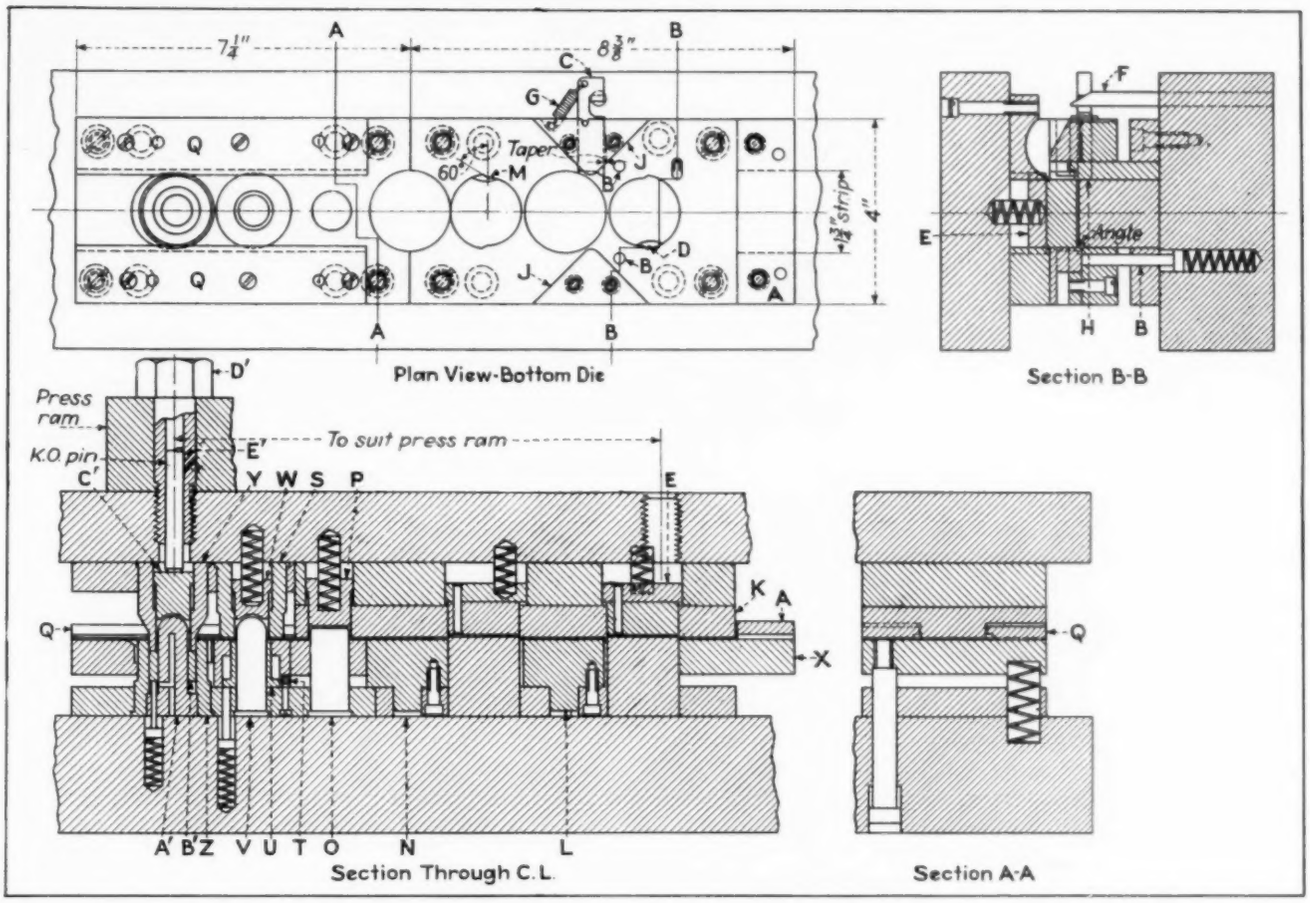


Fig. 2—Seven successive operations are handled in this compound die without deforming the strip stock or changing center distances thereby improving production

cient depth to provide for the reduction that follows in the next station. Failure to do so will result in fractured or badly stretched shells, so that it is better to have an excess of height rather than not enough. The pressure pad *P* is intended only to eliminate trouble which may be caused by an occasional shell clinging to the die walls.

Holding the Blank

The reduction of the shell takes place at the sixth station. It is here that the advantage of holding the blanks to the strip becomes evident. As the ram descends the reducing die *S* contacts the drawn shell which stands above the strip. The shell descends bending the carrying fingers until the shell base is in the plane with the strip stock. The whole strip is now in contact and the shell reduction is made as the press ram continues to descend. At the bottom of the stroke the shell flange and carrying fingers are flattened out in a plane with the strip stock by bottoming on the fixed insert *T*. The sleeve *U* supports the shell during reduction, and strips it from the drawing punch *V* on the upstroke of the press ram. The upper pressure pad *W* eliminates any possibility of the shell staying in the top die, *S*.

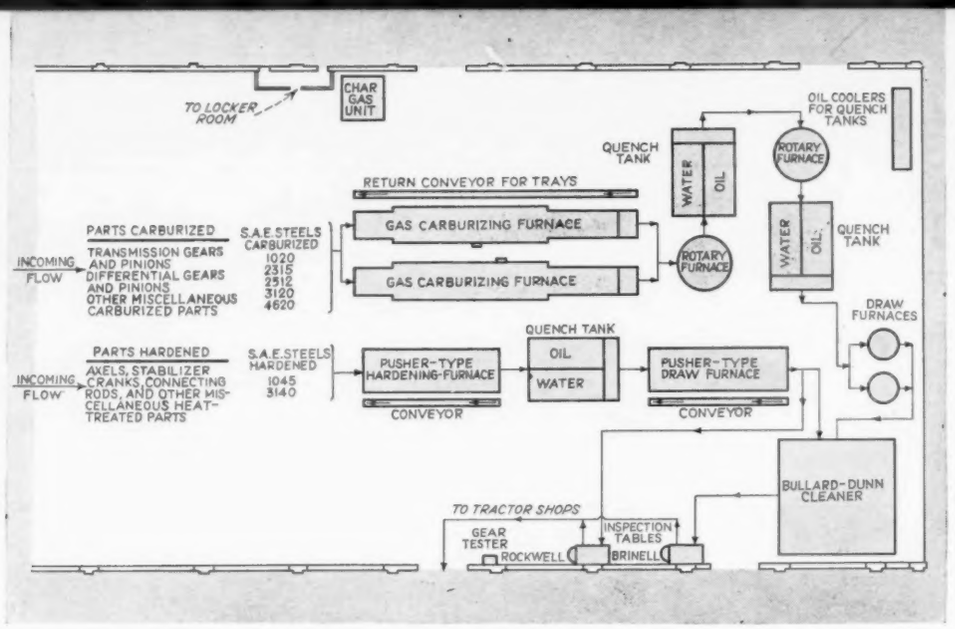
At the seventh station the unit *Y* first contacts the reduced shell. Just as it does in the previous station, the shell descends ahead of the strip stock until it contacts the lower unit *Z*. Continuing the downward movement, unit *Y* is forced over the shell diameter, contacts and blanks out the shell flange on unit *Z*, continues downward and completes drawing the flange. The shell is stripped off plug *A'* on the upstroke of the ram by pressure ring *B'*. The completed shell is carried upward in unit *Y* until removed by knockout pad *C'*, when it falls through the back of the inclined press into a conveniently placed box.

It will be noted that the upper die shoe is attached to the press ram by means of two hexagon head screws. The $\frac{7}{8}$ in. screw *D'* is drilled through the center for the knockout pin *E'*. The upper end of this pin is attached to an angle piece (not shown) which is bolted to the gibs of the press ram. Thus as the press ram ascends to its upper position, the knockout pad contacts the stationary knockout pin and the shell is removed. The pin does not contact the pad at the bottom of the stroke as it appears in Fig. 2, but will be above the pad a distance approximating the stroke of the press.

Always the Torch

Nothing in mechanical lines has made greater and more far-reaching progress in a short time than flame and electric welding. It is not much more than 30 years ago that flame welding came into use. Yet it is hard to find places today where it is not used. I have seen it in small shops in far off Corea, and it is also a part of standard equipment in similar shops in Mexico.

No matter what the kind of work, the ability to cut metal, to build up worn places, to weld small parts complete whole, makes it one of the leading items on the shop list. Given a lathe, a drill press and an oxy-acetylene outfit, a good mechanic can repair or rebuild a large variety of machinery.



Flow of work through the tractor heat-treating department is indicated on this layout. Propane gas is used to heat the furnaces

Gas Makes Tractors Tough

Both as a fuel and as a carburizing agent propane proves its worth in Allis-Chalmers' new heat-treating department

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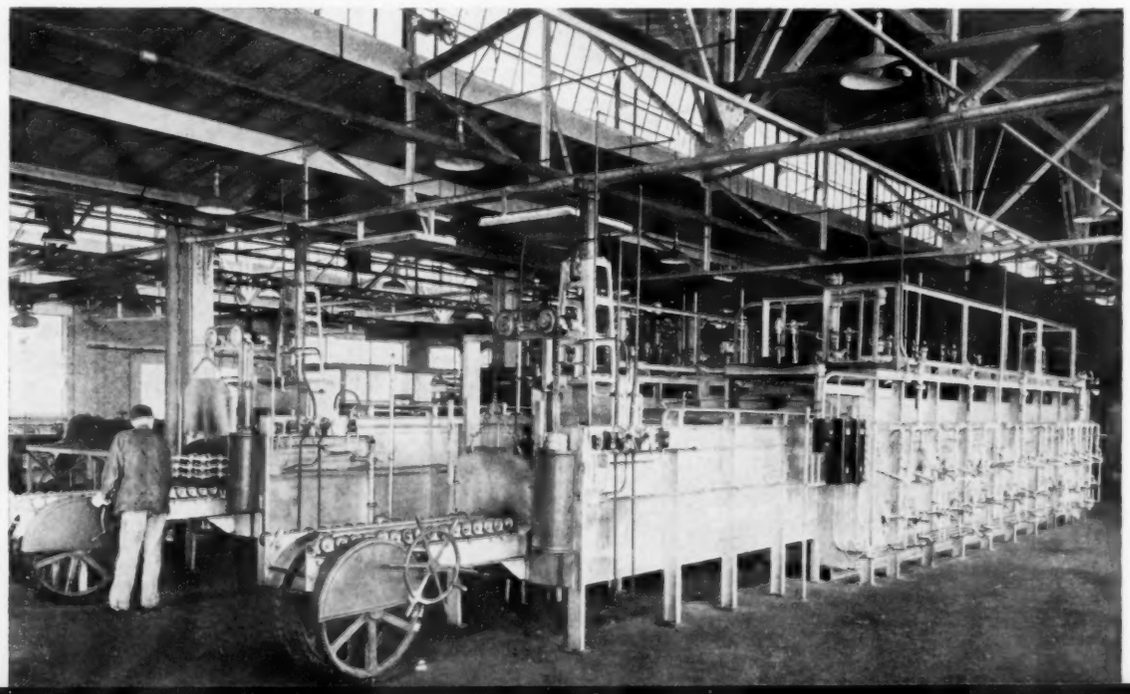
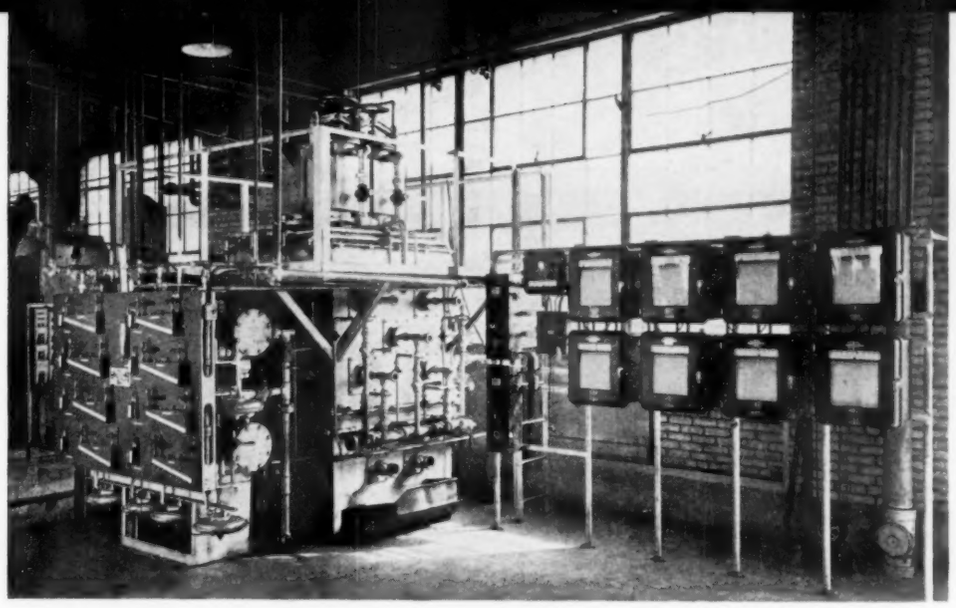
Research Department, Manufacturing Division
Allis-Chalmers Manufacturing Company

DURING the early stages of a recent tractor-plant expansion program, Allis-Chalmers engineers made a thorough analysis of the heat-treating requirements of those parts already in production and those still in various stages of development. Selection of new equipment, fuel, quenching presses and dies, as well as jigs and fixtures for inspection operations, was based on these studies. Where necessary special units were designed and built to meet particular requirements.

Changes in our tractor heat-treating department can be roughly divided into three periods. Twenty years ago furnace equipment, designed and manufactured by Allis-Chalmers for its heat-treating department, used fuel oil of 26-28 gravity with either high- or low-pressure air for atomization. Quenching presses of the straight-piston type at that time proved inadequate in holding large sections of gears and pinions, so we designed and put into operation our own quenching presses, dies and fixtures. Through the years these presses have been perfected and the same fundamental principles still are used in the toggle-type quenching presses now in operation.



All controls for unloading, operating charge and discharge valves, and starting the tray pusher, are located at the discharge end of each carburizing furnace



Heart of the gas carburizing furnaces is this four-tube char gas unit. Control panel and temperature control instruments for both furnaces are located here. Each furnace has four zones of temperature control

About ten years ago, when the company again expanded its manufacturing facilities, electrically-heated, counterflow-type solid pack carburizing furnaces were installed. Electric rotary furnaces and smaller recirculating-air type electric draw furnaces were also included. These furnaces were placed in an extension to the old treating building which housed nothing but electrically heated equipment.

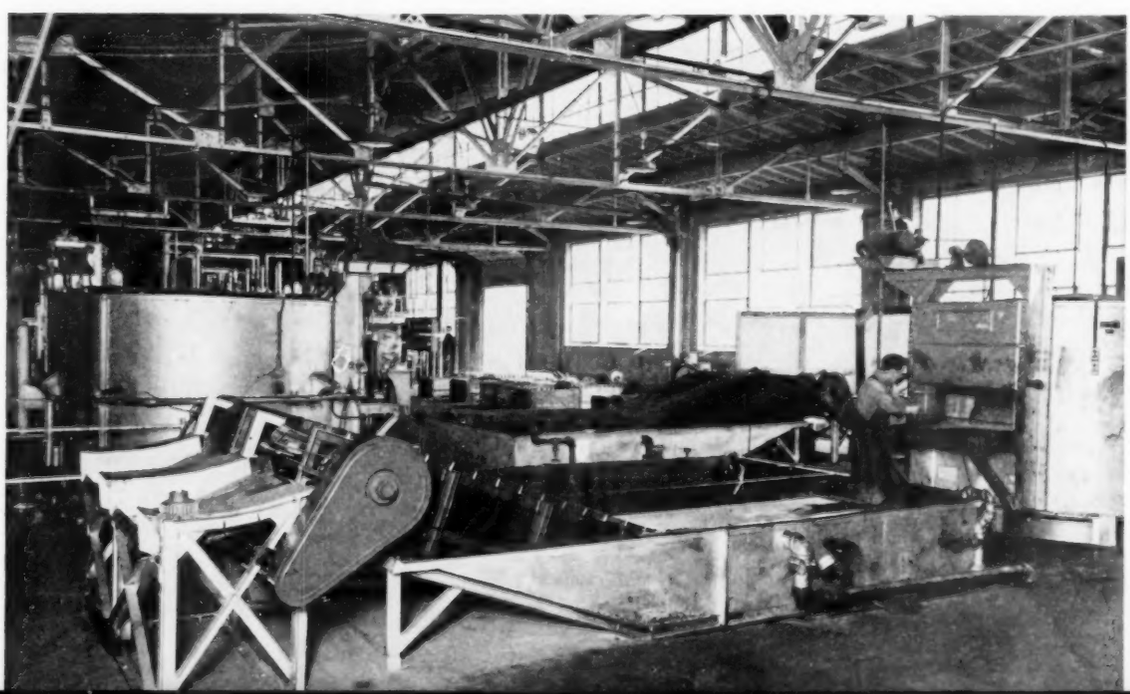
In the expansion recently undertaken by the company, consideration was given the various types of industrial gases, and it was decided to use propane in the new tractor heat-treating extension. This gas is adapted for use in the heat-treating department and also for the core ovens in the foundries, which are adjacent to the heat-treating department, and for the motor test floor.

Propane is received in tank-car quantities and stored in two tanks, each with a capacity of 35,000 gal. Adjacent to the storage tanks is a building housing the vaporizers and a general metering system. The gas is delivered to the points of consumption at a pressure of 25 lb. per sq. in. At these points are stages of secondary reduction where the pressure is reduced to approximately four to eight inches of water. Meters are located in the tractor heat-treatment department, in both foundries, and at the motor test floor to allocate the consumption of propane gas.

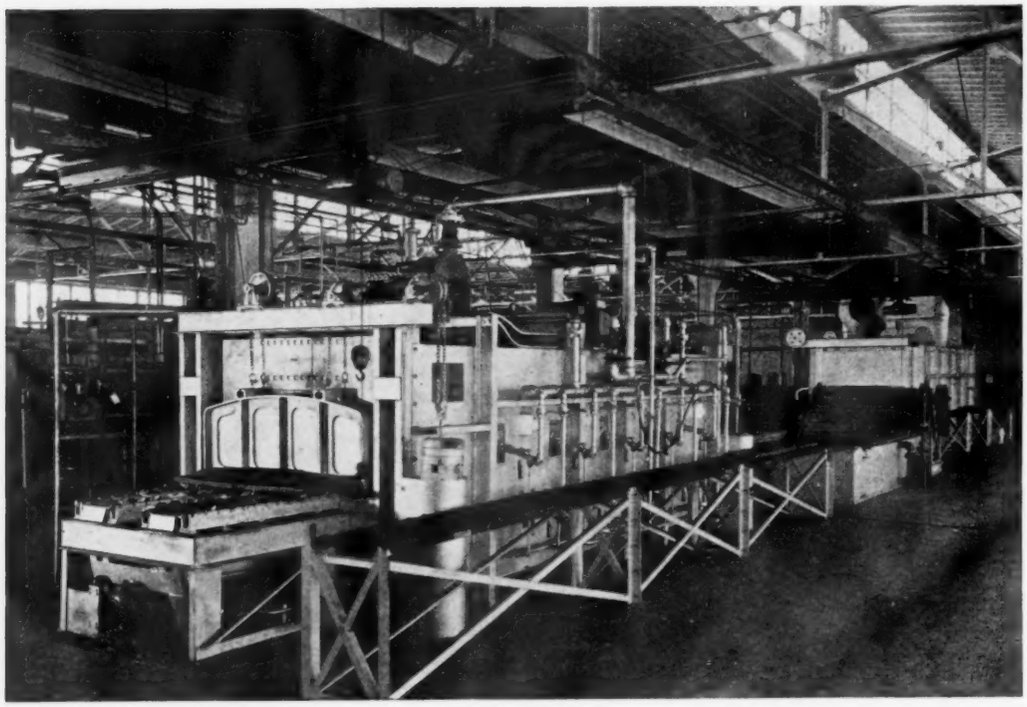
The equipment recently installed in the tractor heat-treating department may be divided into two broad classes—a complete line for the treatment of low carbon steels, and an independent line for heat-treatment of higher carbon steel forgings. Furnaces used in treating the carburizing steels include two muffle-type gas carburizing furnaces, with a carburizing gas preparation unit, two rotary hardening furnaces with oil and water quenching tanks, and two recirculating-air type draw furnaces. Heat-treatment of axles, stabilizer cranks and similar forgings is done in a pusher-type hardening furnace, with combination oil and water quenching tanks, and a pusher-type recirculating-air draw furnace. Cleaning and inspection equipment is arranged in such a manner as to receive heat-treated material direct from both lines.

In order to control tractor forgings at the earliest stage in the manufacturing process, two oil-fired pusher-type cycle annealing furnaces were installed in the forge shop. The cycle, as set for each forging, consists essentially of a preheat, soak at temperature, fast cool, and slow cool. Work is lifted from the discharge end of each furnace by means of a hoist, loaded into a Wheelabrator cleaning unit, discharged into skids prior to inspection and shipped to the tractor shops.

With few exceptions, all gears and pinions for Allis-Chalmers tractors are carburized in one of two muffle-type gas carburizing furnaces. The operator loads an alloy tray with trac-



Carburizing is followed by hardening in rotary furnaces, each served by a combination oil and water quench tank. Developed by Allis-Chalmers, these furnaces are fired by a unique method



Pusher-type furnaces separated by a combination oil and water quench tank are used to harden and draw axles, crankshafts and similar parts. Handling facilities are provided to take care of the heavy forgings

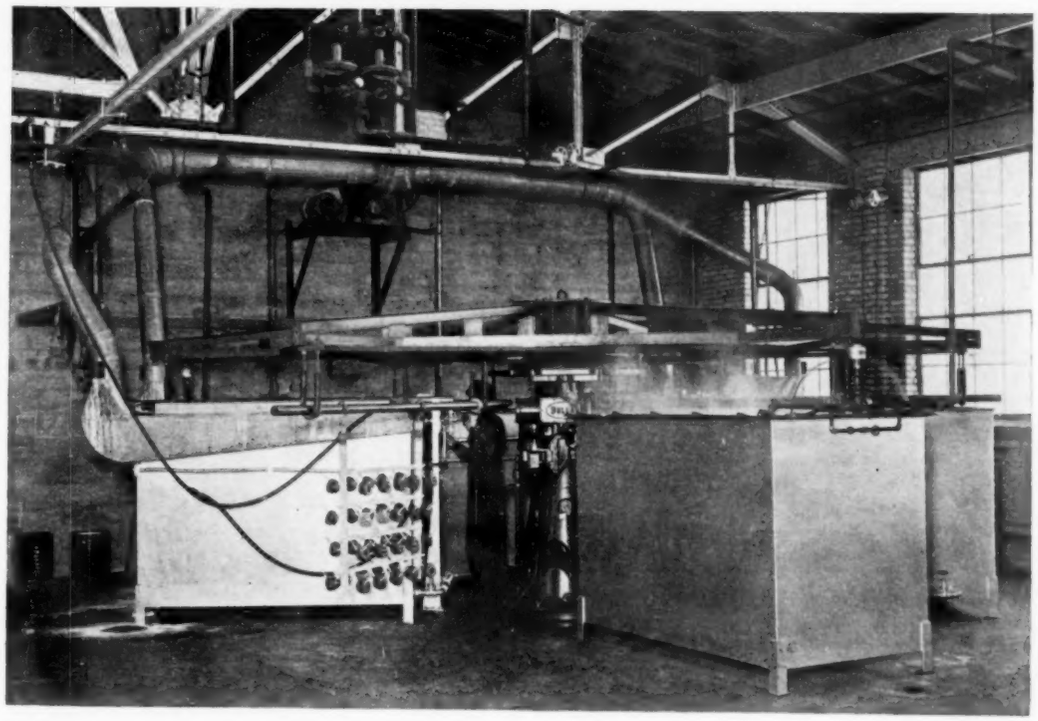
tor parts, using spacers and fixtures designed to give adequate support and to permit circulation of carburizing gas around the work. After inspecting the tray load, the operator rolls the work into the charge vestibule, which is continuously purged to prevent infiltration of air into the muffle.

When it is time for the next tray movement, the operator stations himself at the discharge end of the furnace and raises the air-operated discharge valve that seals the muffle at the end of the cooling zone. With a hand-operated windlass he draws a tray into the discharge vestibule and then lowers the discharge valve. Next, he raises the charge valve; a signal flashes when this operation is completed. The pusher then is started and a new tray is pushed into the muffle. A second signal flashes, indicating the end of the push, and the operator lowers the charge valve to seal the muffle. All of these operations are controlled at the discharge end of the carburizing furnace.

Carburizing Gas Prepared

Essentially, the four-tube char gas preparation unit is a furnace used in heating four vertical alloy retorts for the preparation of the carburizing gas. Hardwood charcoal is fed into hoppers at the top of each retort and descends by gravity through the alloy tubes; the ash drops into a pan that forms a water seal at the base of the retorts. Propane gas and air in regulated amounts pass upward through

Some tractor parts are heated in this electrically-heated salt bath furnace. The cyanide salt bath is checked daily by the laboratory



All tractor parts are cleaned, after the drawing operation, in a Bullard-Dunn descaling unit. Here the parts are both cleaned and given a protective coating of tin plate

the incandescent charcoal. The carburizing gas resulting from this cracking process is rich in carbon monoxide and hydrogen with a small amount of hydro-carbons of varying analysis and contains practically no oxygen or carbon dioxide.

This gas passes through a cooling coil and a filter on the suction side of a small gas pump. Delivery is made to five inlet ports at the top of the muffle in each furnace. At each inlet a regulated amount of raw propane is injected with the carburizing gas. The spent carburizing gas is exhausted through an outlet pipe and is burned in the atmosphere.

As indicated on the flow sheet, carburizing is followed by hardening in two rotary hardening furnaces. Each of these furnaces has a capacity of 920 lb. per hr., thus permitting core and case treatment of the total output of the carburizing furnaces. These hardening furnaces embody several unique features, the most outstanding of which is the method of firing. A controlled propane-air mixture is ignited at a single vertical burner, and the flame passes upward through a conical duct in the center of the hearth, deflecting in all directions from the arch. By this time combustion is complete and the result is that there is no flame impinging on the material heated.

Length of flame and furnace atmosphere are readily adjusted with this method of firing. The umbrella-like action of the flame eliminates both the possibilities of a hot zone or of cross drafts in the furnace. This same flame action assures proper temperature control at the door, eliminating the possibility of a drop in the temperature of material just before quenching.

All tractor parts that have been carburized and hardened are drawn in recirculating air-type furnaces which burn propane in a separate firing chamber. The products of combustion are forced down through the charge. Location of the thermocouple at the entrance ports to the furnace chamber controls the temperature of the entering hot air, thus preventing overheating of any part of the furnace charge.

Treatment of Tractor Forgings

Tractor forgings, such as axles, stabilizer cranks, crankshafts and similar parts are heat-treated in two pusher-type furnaces. Work is passed through the hardening furnace on double trays at a net rate of about 1,275 lb. per hr. After heating to a temperature dependent upon the mass, the composition of the material and the physical characteristics desired, the work is quenched either in oil or water. The method of tray loading and rapid-action hoists facilitates the loading and quenching of heavy forgings.

Forgings and other parts are then tempered in a recirculating-air type draw furnace. Hot air is supplied by an individual heater located on top of the furnace and a recirculating fan forces the hot air down into the furnace and up around the work. Close control of the atmosphere results in a light, soft scale on the parts treated. As a result, it has been found possible to eliminate cleaning of forgings that are machined completely after heat-treating.

Quenching oil is circulated by Allis-Chalmers centrifugal pumps through several quenching-oil coolers using water from the power house condenser cooling pond. The coolers, pumps, and tanks are interconnected in such a manner so that the same oil can be circulated to any quench tank in the heat-treating department.

Analysis of carburizing gas is made with "Burrell" equipment at a specified time during each of the working shifts. Case depths and hardnesses are controlled hourly and microscopic analysis of quality of case and core are made continually in the laboratory controlling these operations.

Heavy forgings and carburized and hardened parts are inspected with a power-operated, direct-reading Brinell machine before leaving the heat-treating department. Gears and pinions are tested with either Shore Sclerescope or Rockwell hardness testing units. Hardness tests of gears and pinions are followed by the usual plug and gage tests to check bore and keyway dimensions. When testing is completed, and before shipping to the adjacent tractor plant, the gears are checked for pitch line run-out and quietness of operation in a specially designed motor-operated rolling fixture.

PRESS WORKING OF METALS • NUMBER 10

Inverted Dies

Construction principles of plain and compound tools and methods of blank and slug disposal are given, as the subject of plain cutting dies is continued

C. W. HINMAN
Tool Engineer
Kobzy Tool & Electric Mfg. Company

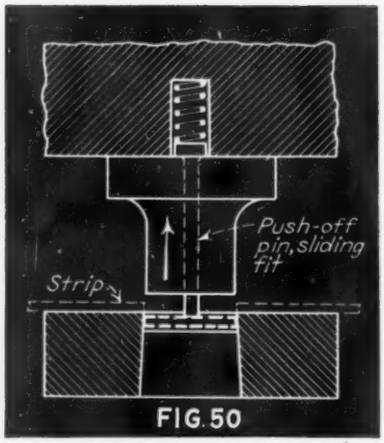


Fig. 50—Small, thin oily blanks of regular contour are likely to adhere to the punch face during ascent, so a push-off pin sliding through the punch holds the blank down in the die

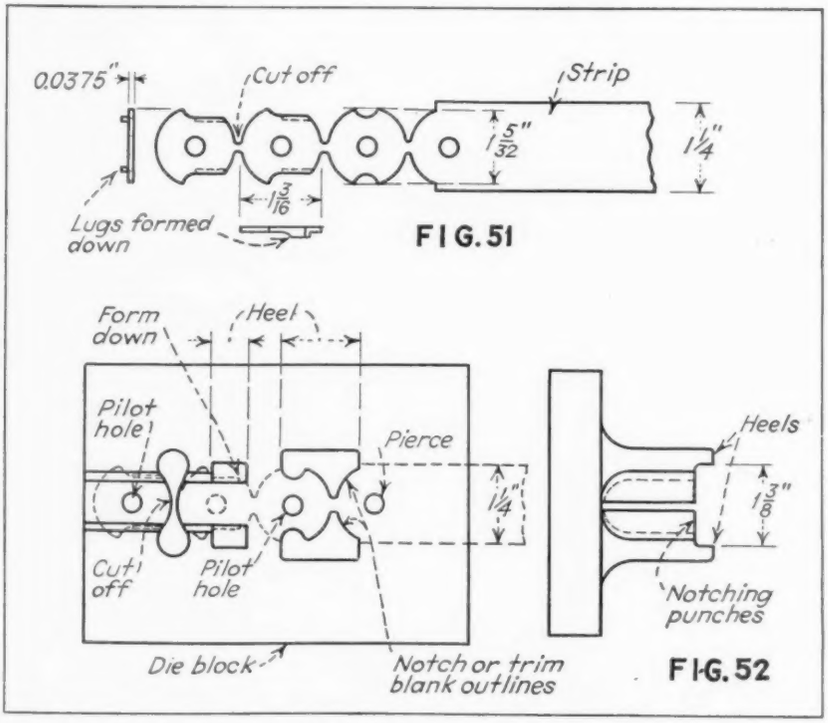


Fig. 51—Most varieties of die work are performed in progressive dies, of which this strip is a sample of how a typical sequence of operations is performed. Fig. 52—Notching punches in progressive dies must have a heel that enters the die before the cutting edge contacts the strip, thereby guiding the punch and preventing shearing or nicking of the cutting edge

A BLANK may be too thin or too regular in outline to "cling," as it must, in the die opening after blanking. This difficulty often occurs when using a lubricant on the strip. Excessive oil causes the piece to adhere to the punch and follow it up in ascent. Faulty die making also causes this trouble. If the die opening is filed incorrectly, slightly flared outward toward the top instead of having vertical sides, the die may fail to retain the blanks.

Safe tool engineering specifies one or more push-off pins in all blanking punches for small thin blanks of regular contours. The pins are $\frac{1}{16}$ to $\frac{3}{16}$ in. in diameter, or to suit the blank size, and slide through the punch as shown in Fig. 50. The pins normally protrude beyond the punch face about $\frac{1}{4}$ in. A light compression spring is placed over the head of the pin in the punch holder. These "push-off pins" hold the blanks down within the die while the punch ascends.

Push-off pins are sometimes inserted through the die block with the compression spring placed under it in the shoe. The idea is to lift the work slightly and thus facilitate the strip movement, or to elevate the strip and clear a formed part on the blank over a die edge. This necessity often arises in the design of progressive dies where the blank outline is cut with notching punches from either side of the strip, and being attached to the strip, is advanced into subsequent stations for additional operations. The ends of the pins have rounded noses and the strip slides over them easily; the pins project above the die face about $\frac{3}{64}$ in.

The progressive notching die notches or trims a blank from either side of the strip, and leaves the blank

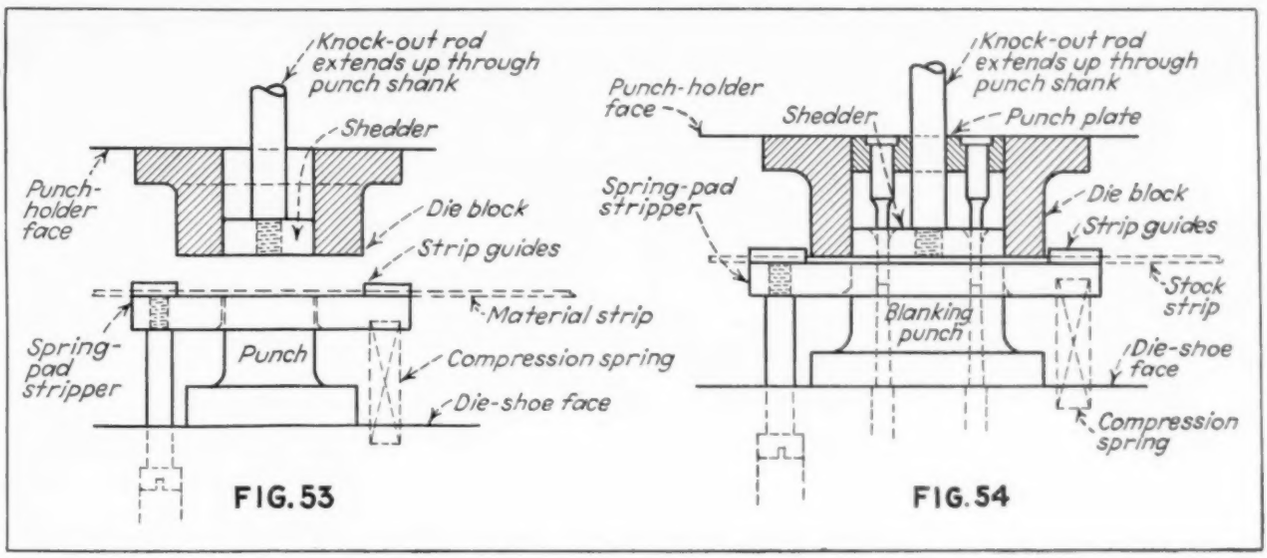


Fig. 53—Inverted blanking dies can be used on inclined presses wherein the press-bed opening is too small for the blank to drop through. Fig. 54—A compound, inverted blanking die has the advantage of locating pierced holes in accurate relationship to the blank contour

and strip attached by a small neck. The blank and strip are then passed along into successive stations where all varieties of die operations can be performed. These dies are high speed producers of small parts, and are very satisfactory if properly designed and constructed. Dies of this type are well known in connection with high-speed presses, multi-slide and dieing machines. In Fig. 51 are three views showing typical operations on a strip taken from one of these dies.

In progressive dies, the blank and strip are often, but not always, the same width. There is no scrap skeleton to pass out of the die after the piece is made. The scrap is simply small slugs and notching waste, and perhaps a narrow cutting-off waste across a small connecting neck between blank and strip. The pieces made are small clips, brackets, and terminals or connector lugs, all of which are of light-gage thicknesses. The sequence of operations may be: notch, pierce, emboss, draw, form and cut off. The number of working stations may run up to eight or ten.

In the first station, when the ram descends, two punches cut outlines of the blank, one punch at each edge of the strip, leaving a small connection to the strip. A pair of notching punches are sketched in Fig. 52. The important feature is the heel on the punch which enters the die opening ahead of the cutting edges. This precaution protects the sharp edges from shearing off or nicking as might otherwise be expected from an unbalanced cut such as notching. The heel guides the punch into the die, and prevents punch deflection in three directions, and thus prevents damage to cutting edges when taking "biting in cuts" which would otherwise certainly occur without the safeguard of backing heels.

When forming lugs "up" in these dies, the strip is raised $\frac{1}{16}$ in. by passing it up and over a small open ramp on the die face. In the next descent of the ram, a forming punch "throws up" the lugs between the inner sides of the ramp. A "push-off pin" underneath the forming station, and another one within the forming punch, frees the work for the next advance of the strip.

Often it is found necessary in press tools to reverse the positions of the cutting members in the die set. The punch then becomes the lower member and is attached to the die shoe, while the die is mounted over it on the punch holder. A spring pad, retained by stripper screws in the die shoe, surrounds the punch. The surface of the pad is normally flush with the punch face. It guides the material strip over the punch, and at the same time, locates the strip edgewise between the slotted guides shown in Fig. 53. When the ram descends, the die depresses the pad an amount equal to the distance the punch enters the die, plus the thickness of the work material. The blank has now been cut into the die, and the material strip has been cut through, and clings around the punch. When the die ascends, the spring pad follows it and carries up the strip from around the punch, or "strips it off the punch," as a diemaker would say.

After the blank has been cut into the die, it is ejected by a "knock out" shedder which has an attached vertical rod, as shown. The shedder is a free fit within the die opening. Blank ejection occurs near the top of the ram ascent, at the moment when the free end of the knockout rod contacts the ejector bar which extends through the head of the press. The sudden contact depresses the shedder, which lies behind the blank, and instantly pushes out the piece. Press tools of this type are usually "set up" on an inclined press; the ejected pieces slide off the die and then fall into a chute which conveys them into a container behind the press.

There are several advantages in using inverted blanking dies. This tool is quite unlike the conventional blanking die in which the blanks pass through the die and bolster and then fall beneath the press. Inverted dies have the advantage of using a solid bolster and a minimum size of opening through the press bed. It is therefore possible to use a press which has an opening in the bed too small for the blanks to drop through, which would be difficult to do using a conventional blanking die. The solid die shoe and bolster plate, and the minimum size press opening under them, provides maximum resistance against the thrust of heavy cuts and a noticeable absence of vibration during the cutting interval.

There are further advantages in using inverted blanking dies. If holes or openings are to be cut in the blank the necessary punches can be located within the die and be extended through holes in the shedder plate, Fig. 54. Corresponding die holes for

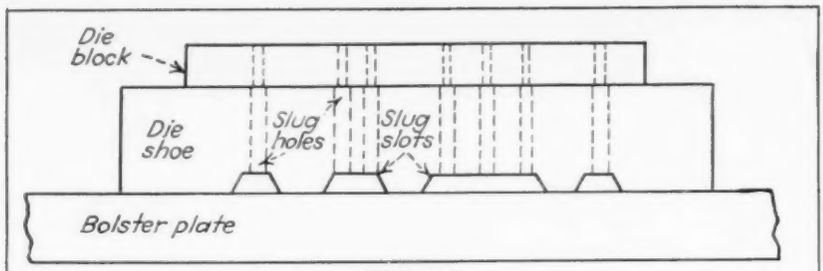


FIG. 55

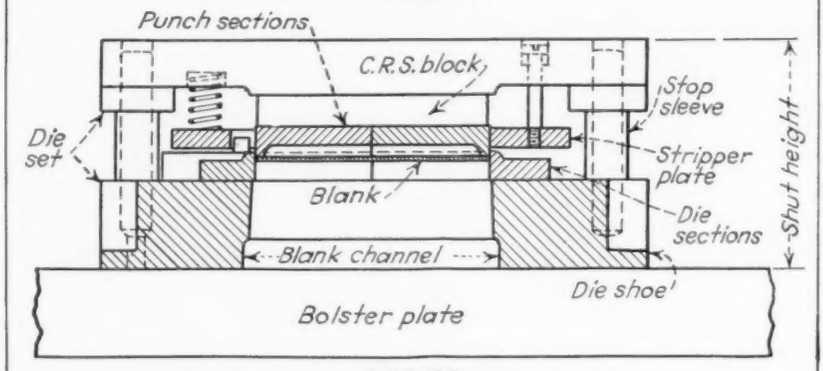


FIG. 56

Fig. 55—When perforated holes are widely scattered and the slugs will not fall through the press-bed opening, cross slots are machined in the underside of the die shoe, and the slugs can be pushed out occasionally. Fig. 56—Large blanks that will not pass through the press-bed opening are removed from a blank channel underneath the die shoe

the cuts are provided in the face of the blanking punch. Thus we have a simple type of semi-compound die in which the locations of all the pierced holes are in accurate relation to the contour of the blank. Accuracy is due to cutting the blank and holes simultaneously, but the tool must be true.

Occasionally, one is confronted with a die designing problem that is solved best by using an inverted die. This condition often appears at one or more stations of progressive dies when shearing, forming, embossing or drawing certain parts either up or down from the surface of the material strip. In such cases, one finds that an inverted die will sometimes avoid interferences in passing along the strip. There are also times when both the conventional die and the inverted types are combined in one station, or at different stations in progressive work. Therefore, when the designer seems to be "stumped" in procedure; turning the drawing upside down may give him the desired clue which suggests that an inverted design is best.

In very large piercing dies, where perforated holes are widely scattered, and some are too far removed for the slugs to fall through the opening in the bed of the press, the die shoe casting is made with a series of parallel cross slots underneath it. The slots are positioned under the holes that lead from the die. After piercing, the slugs fall through into these slots and lie on the bolster plate; they are pushed out or blown out with an air nozzle, Fig. 55.

Using cross slots underneath the die shoe, as just described for the disposal of pierced slugs, is an idea well adapted for disposing of blanks which are too large for passing through the opening in the press bed, Fig. 56. After being cut, the blanks fall into the die shoe channel and are then easily pushed out.

The sketch also shows "stop sleeves" around the guide posts. This feature aids the die setter in adjusting the ram to its shut height; it also checks the lost motion in a worn ram slide. The tool steel punch sections are "backed" with a cold-rolled steel block; this is economical in the use of tool steel. When it is possible to use a one-piece punch, a composite steel block is used; such blocks are of machinery steel having a "welded on" tool steel face. This material is sometimes called "steel clad blocks." In large dies, the punch holder is usually secured to the ram with bolts, hence the punch shank is omitted.

Part II of Mr. Hinman's series will appear in an early number.

Staggered Gears for Crushing Apples

Staggered gear teeth were the forerunners of helical and herringbone gears. The pair of gears of this kind shown are from the collection of old machinery in the Mercer Museum in Doylestown, Pa. The teeth are inserted endwise so as to secure the strongest combination possible.

But instead of being used for transmitting power, these gears were used for crushing apples in the cider mill, before the mash, or whatever it was called, went to the screw press. When one begins to study old machinery it is surprising how many of the beginnings of modern devices are to be found.

AMERICAN MACHINIST *Reference Book Sheet*

Co-ordinates for the Jig Borer

Constants for Locating Holes Spaced Around a Circle

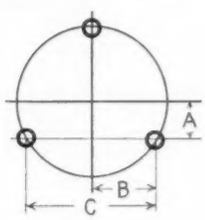


FIG. 1

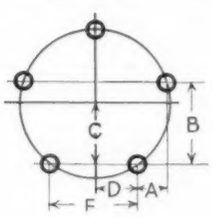


FIG. 2

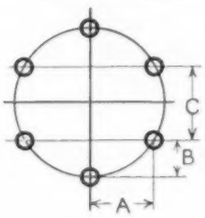


FIG. 3

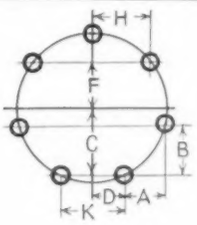


FIG. 4

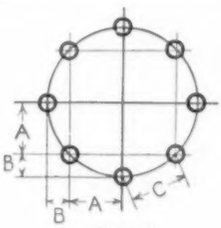


FIG. 5

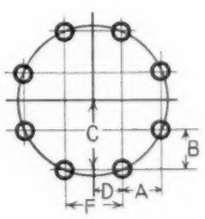


FIG. 6

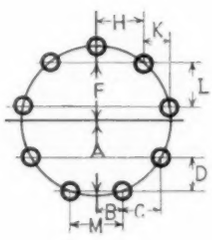


FIG. 7

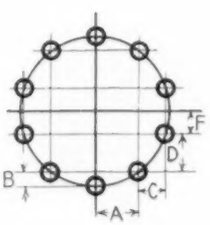


FIG. 8

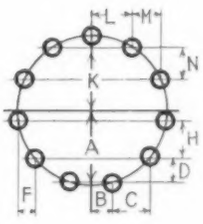


FIG. 9

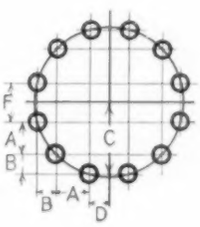


FIG. 10

Multiply Value Shown by Diameter of Circle Being Calculated

Fig. No.	No. of Holes	A	B	C	D	F	H	K	L	M	N
1	3	0.25000	0.43302	0.86603							
2	5	0.18164	0.55902	0.40451	0.29389	0.58779					
3	6	0.43302	0.25000	0.50000							
4	7	0.27052	0.33920	0.45049	0.21694	0.31175	0.39090	0.43388			
5	8	0.35355	0.14650	0.38268							
6	8	0.27059	0.27059	0.46194	0.19134	0.38268					
7	9	0.46985	0.17101	0.26200	0.21985	0.38302	0.32139	0.17101	0.29170	0.34202	
8	10	0.29389	0.09549	0.18464	0.25000	0.15451					
9	11	0.47975	0.14087	0.23701	0.15232	0.11704	0.25627	0.42063	0.27032	0.18449	0.21319
10	12	0.22415	0.12941	0.48297	0.12941	0.25882					

Prepared by: Paul Glaesmer

IDEAS FROM PRACTICAL MEN

Machining a Mile and Three-Quarters of Slots

E. P. WITHERS
Manager, Withers Machine Works

Some time ago we had to machine slots 3/32 in. wide and $3\frac{3}{4}$ in. long in a very large lot of ring rails for textile mill twisting frames, the slots being for the reception of separators between the ring openings. While the rails were all of the same width they varied in length, having from nine to sixteen slots in each. The total number of slots in all the rails was 32,600. The job had to be done in two operations because the saws with which the slots were cut left them shorter at the back of the rail than at the front, and the ends had to be trimmed in another set-up to make them square.

Since we had no milling machine large enough for the job, the first operation was done in an 18-in. x 8-ft. lathe, the set-up being shown in Fig. 1 at *A*. One of the rails is shown at *B*. The compound rest was removed and in its place was mounted the fixture *C* for holding the rails, which were supported at the bottom by a bar of 1 x 2-in. cold-rolled steel 48 in. long. The saw arbor carried five 4-in. slitting saws 3/32 in. thick and correctly spaced. The saws were all at the tailstock end of the arbor, the headstock end being blank. The shank of the arbor was held in the spindle, and at the outer end and in two other places it was supported by the special rests *D*, as indicated in the sketch.

In operation, a rail was held in the fixture and fed to the saws by the cross-feed screws. After five slots were sawed, the rail was relocated and five more slots cut. In the case of a rail having sixteen slots, fifteen slots were sawed in three passes. Then it was relocated so that four saws entered slots already cut, leaving one saw to cut a new slot. All rails having a number of slots not evenly divisible by five were treated in the same general way.

For squaring the ends of the slots we had to build a special machine. It was not unlike a crank-operated keyseater in which the ram is below the table. The details of the set-up on this machine are shown in Fig. 2. Two power hacksaw blades *A* and *B* were pinned to the adapter *C* which was attached to the ram. The upper ends of the saw blades were bevelled so as to enter the slots easily. The stroke of the machine was such that the upper ends of the saw blades were flush with the top of the work at the end of the down stroke. The backs of the saw blades were normally drawn toward each other by the pull spring *D* and were spread apart by hardened pins when the twin disks *F* were rotated by depressing the lever *H*. The arrangement of the twin disks and the hardened pins is shown at *I*, the space between the disks being for the admission of the saw blades.

In operation, with a rail clamped face down on the table, being located sidewise by stops and endwise by the saw blades entered in one of the slots, and the machine in motion, lever *H* was progressively depressed at the down strokes of the saw blades, rotating the twin disks and causing the hardened pins to spread the saw blades outward to the cut. After one slot was finished, the rail was relocated so that the saw blades were in the next slot, the operation being repeated until all the slots were squared at the ends. About six strokes were enough to square the ends of each slot.

Since the saw blades were well supported by the slots in the work and by the inner sides of the twin disks, the breakage did not amount to more than two dozen saw blades during the whole job, which took about nine months to complete.

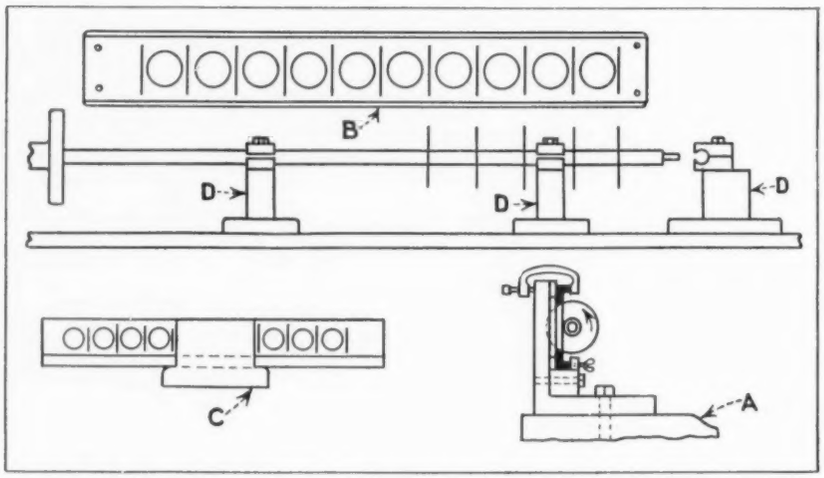


Fig. 1—Five slots were cut at a time by a gang of saws, the work being relocated for cutting the additional slots

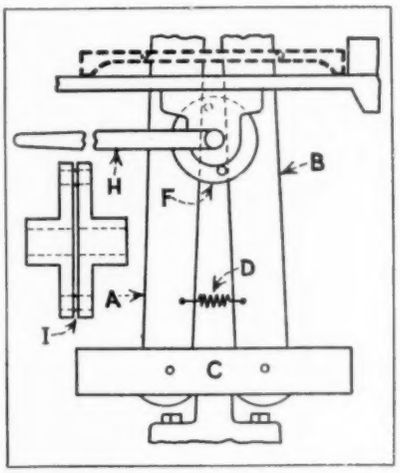
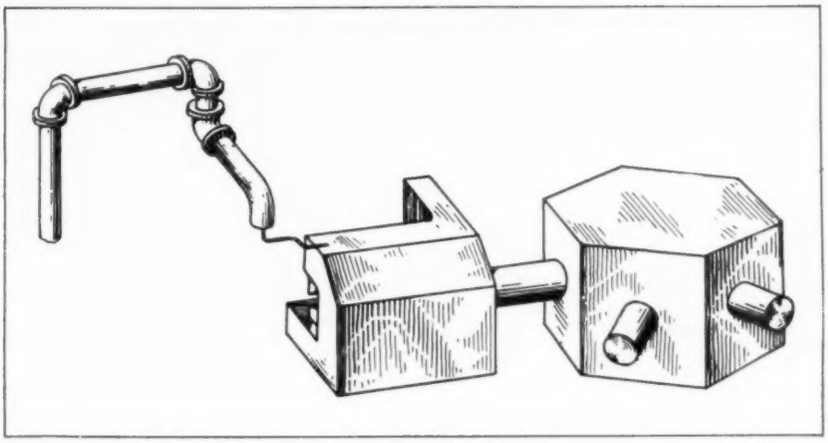


Fig. 2—With the work clamped on the table, the ends of the slots were squared by two reciprocating hacksaw blades



Wire soldered to a box tool with its free end entering the pivoted oil pipe will make the pipe follow the tool and keep it flooded

Oil-Flow Guide

C. W. ANDERSON

In operating a screw machine it is sometimes necessary to have oil or coolant follow the box tool or turret cutters to keep them flooded during their cuts.

One way of accomplishing this is to solder a piece of heavy wire to the top of the box tool. The free end of this wire is bent upward, entering the mouth of the oil pipe, which is pivoted in two places to permit a long and easy motion.

The wire should be bent so that when engaged in the pipe the oil stream is directed onto the cutters. In operation, the wire will pull the pipe along with it as the tool advances, thus keeping it flooded during its entire cut.

Additional wires may be soldered to the top of the turret above those tools which should be kept flooded. When this is done, the oil pipe is lifted from the wire before the turret is indexed, then placed over the next wire when the corresponding tool is ready to make its cut.

Checking a Jig With the Camera

J. E. MOORE

Recently an aircraft factory, which uses a camera to such an extent that they employ a full time photographer, found that a cluster of tubes used on a certain ship was not properly centered. This cluster, as shown in Fig. 1, consists of four tubes *B, C, D* and *F* which are welded to tube *A* and are designed to have all of their center lines intersect at a common point.

Checking this arrangement was extremely difficult until someone hit upon the idea of using the camera for this purpose. A model joint was made up in the welding jig and this model was centered and squared up on a rotary table, as indicated in Fig. 2. The camera was focused on the joint from a distance of approximately 20 ft.

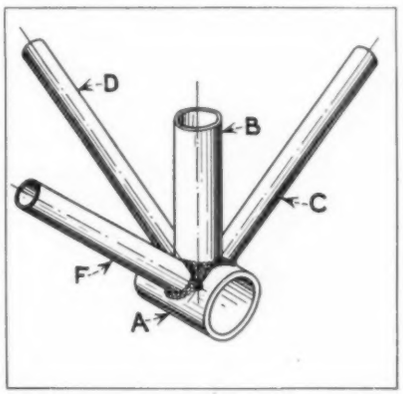


Fig. 1—Checking this cluster of tubes was difficult by ordinary means, but a misalignment was determined easily by making four photographs

A front view then was made, following which the table was rotated first to one side and then the other for views at 90 deg. right and left of the center position. Next, the joint was set up on an angle plate for making a top view.

Enlargements were made of all four of these views and center lines were drawn through each tube on each view. In doing this, it was found that the center line of one tube failed to pass through the common center point. With this information available, it was an easy matter to correct the jig.

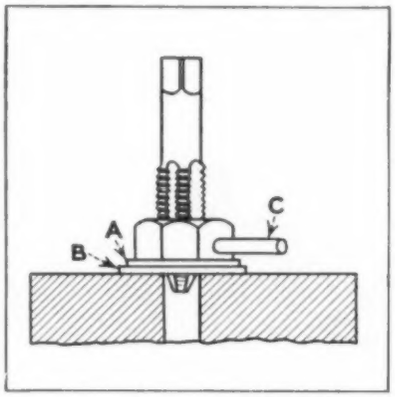
Tapping Holes Square With the Work

GEORGE J. MURDOCK

Murdock Research Laboratory

In tapping holes square with the face of the work it is often the practice to screw a faced nut on the end of the tap, the nut being brought into contact with the face of the work as the tap is screwed into the hole. Unfortunately the tendency is for the nut to lock on the tap and prevent its proper functioning. If the tap is then out of square with the face of the work it may be broken, especially if the torque caused by the pull on the tap wrench is too violent. It is generally necessary to use a wrench to release the nut from the face of the work after the hole has been tapped, leaving scratches on polished work.

If an iron washer *A* and a leather washer *B* be placed under the nut with the leather washer next to the work, the elasticity of the leather



A washer under the nut and a leather washer between it and the work will prevent the nut from locking on the tap

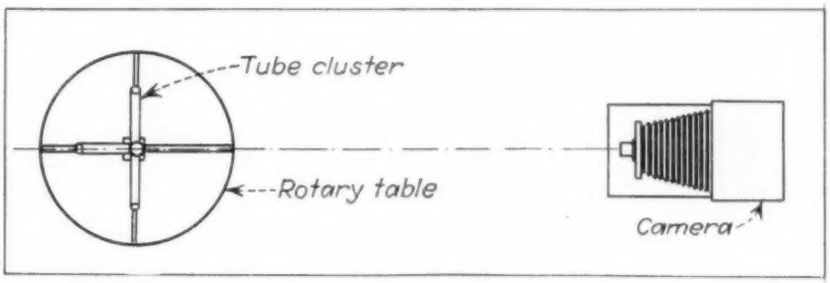


Fig. 2—The cluster was set up on a rotary table and the camera aligned with the center line of the table for making the necessary photographs

washer will prevent the nut from locking on the tap and the iron washer will prevent the sharp corners of the nut from tearing the leather washer. By this simple expedient holes can be tapped square with the face of the work in much less time than by the ordinary method.

It is a good plan to drill a hole in one of the faces of the nut and to drive into it a short piece of drill rod, as at *C*, so that the nut can be loosened before backing out the tap.

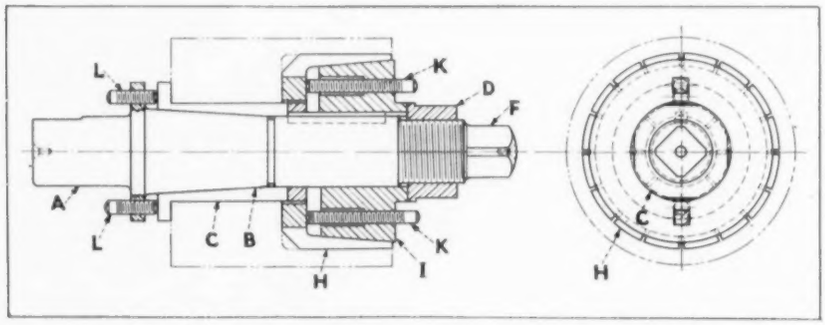
Expansion Mandrel for Two Diameters

J. R. WHITTLES

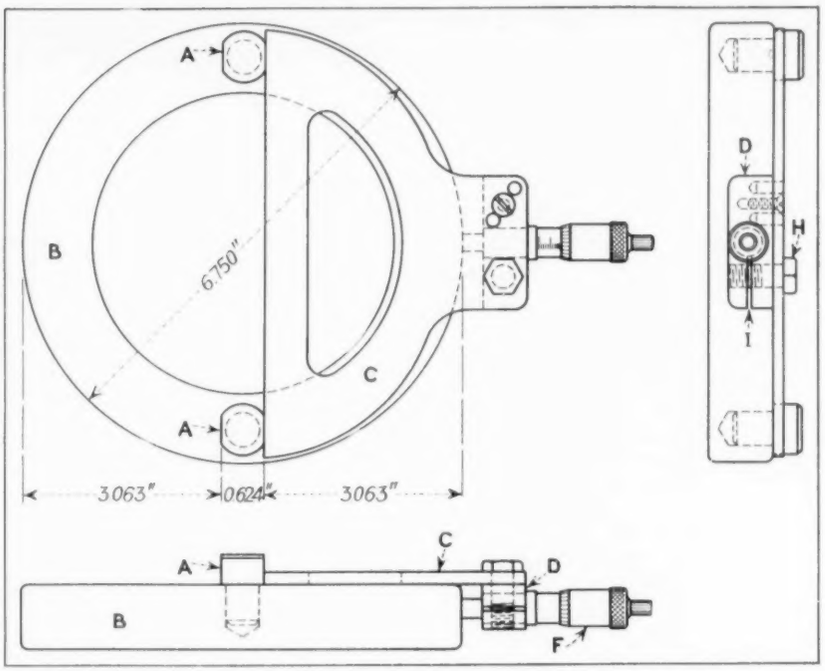
In the illustration is shown an expension mandrel for holding work $18\frac{1}{2}$ in. in diameter and having bores of two diameters, 8 and 16 in. respectively.

The body *A* of the mandrel is machine steel, pack hardened and ground. It is tapered at *B* for the expanding sleeve *C* and is threaded for the tightening nut *D*. The square at *F* is for holding the mandrel with a wrench while the nut *D* is being tightened. The expanding sleeve *C* has eight slits and holds the work by the 8-in. bore, riding on the taper *B*. The expanding sleeve *H* has sixteen slits and is expanded by the plug *I* being forced into its taper bore and holds the work by the 16-in. bore. Screws *K* are for withdrawing plug *I* from sleve *H*, while screws *L* are for pushing sleeve *C* down on the taper *B*, thus releasing the grip of the sleeves on the work.

In operation, tightening nut *D* forces the plug *I* into sleeve *H* and at the same time moves the work along the mandrel. This movement forces sleeve *C* up on the taper *B* on the body of the mandrel, thus expanding the sleeves in both bores and holding the work securely. By slacking off nut *D* and tightening screws *K* and *L* the grip on the work is released.



Sleeves *C* and *H* are expanded in the bores of the work by tightening nut *D*. Slackening nut *D* and tightening screws *K* and *L* releases the grip



This special micrometer permits checking directly a dimension difficult to measure accurately

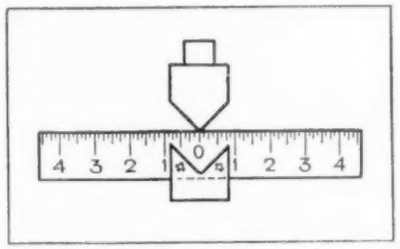
Micrometer Attachment

JOHN W. GERDEL

The illustration shows a micrometer attachment for checking the position of centering pins in a locating ring for a mold for casting aluminum pistons. The centering pins *A* are driven into the side of the locating ring *B* at diametrically opposite points and flats are milled on their sides. The distance from the sides of the pins to the outer diameter of the ring had to be 3.063″ as shown. Since this was a recurring job, the tool illustrated was devised.

The device consists of the yoke *C*, cut from 5/32-in. flat stock; the block *D*; and the micrometer head *F*. The block is drilled and reamed to receive the shank of the micrometer head; drilled and tapped for the capscrew *H*, and slit at *I* so that by tightening the capscrew the micrometer will be held securely.

In use, the yoke is laid on the side of the ring and its ends are held against the flats on the pins by hand. The micrometer spindle is then brought into contact with the outside of the ring and a reading is taken. The micrometer was adjusted so that 0.200″ on the barrel equalled 3.063″ at the edge of the ring.



The work can easily be located by the position of its ends in relation to the scale at the back of the die

A Time Saver in Making Right-Angle Bends

GORDON W. RICHARDS

The sketch shows a time-saving device for use when right-angle bends are to be made in only a few pieces at a time. The scale attached to the back of the die is graduated both sides of the center, the zero corresponding to the V in the die.

The device is available for instant use without the bother of setting stops, since the stock can be located by reading the scale at its ends. The work can be bent so that its legs are either equal or unequal in length.

The Working of WROUGHT COPPERS and BRASSES

AUTHORITIES differ as to how long ago our ancestors learned to work with copper and brass, but by the time of the establishment of the colonies in America, the coppersmiths of Europe were guardians of many secrets of the art that had been passed down from father to son for generations. So careful were these early artisans of their knowledge that the first who came to America from England refused to teach others and demanded that they be permitted to work unseen. The invention of copper spinning by Hayden, of Connecticut, in 1851 gave impetus to the already organized brass manufacturing plants in New England; many of these plants were established in the Naugatuck River Valley section of Connecticut more than 100 years ago.

On the following pages much of the available data concerning the characteristics, applications, and common methods of fabricating wrought copper and copper-zinc alloys, commonly known as brasses, have been summarized. No attempt has been made to list all of the alloys available; those selected for the tabulations being the more typical standard mill alloys that usually are to be preferred for all but very special applications. Wrought bronzes and special alloys of copper will be considered in a later section.

Part of the data used in the preparation of this discussion have appeared in the Metals Handbook, published by the American Society for Metals; in specifications published by the American Society for Testing Materials; in bulletins published by the Copper and Brass Research Association of New York and the Copper Development Association of London; and in trade bulletins made available by the companies that have cooperated in the preparation of this material.

The physical properties and working characteristics of the various forms of copper and copper-base alloys depend to a great extent upon such highly variable factors as size, shape and temper. For this reason any discussion of these properties must be in general terms and approximate values. In fact, it is frequently difficult, without actual trial, to predict whether a given alloy will be suitable for a specific operation. It must be expected that variations from the values given in the accompanying tabulations will be experienced in practice. In the text and tables, references are made to the suitability of the various alloys for different fabricating operations. Ratings given in these cases can be considered as first approximations only and serve to indicate in a broad sense the suitability of the alloy for a given application.

Coppers and brasses are, in most cases, obtainable in a number of tempers in addition to those indicated in the tables. This temper, or hardness, is developed by cold rolling or cold drawing after annealing. The percentage of cold reduction is the determining factor in the degree of temper obtained. Standard temper designations for rolled sheet and strip, as included in the recently published A.S.T.M. tentative specifications for brass sheet and strip (No. B36-38T), are shown in the table on page 1102. These designations also apply to sheet and strip coppers and bronzes, as well as to brasses. In a few instances, tempers much harder than those indicated are used. When this is the case the temper is specified in terms of the reduction as measured by Brown & Sharpe Gage numbers. For instance, 12 Nos. hard would be equivalent to about 75 per cent reduction in sheet.

Annealed tempers for plate, sheet, strip and wire preferably are specified in terms of grain size for all alloys of the copper-zinc group having largely or entirely an "Alpha" structure. Other terms must be applied when the alloy is not substantially all Alpha. The A.S.T.M. specification for brass sheet and strip, mentioned above, lists

Due credit is given the following organizations for data supplied by them toward the preparation of this section:

The American Brass Company
American Gas Furnace Company
American Society for Metals
American Society for Testing Materials
Bridgeport Brass Company
Carboloy Company
The Carborundum Company
Chase Brass and Copper Company
The Cleveland Twist Drill Company
Copper and Brass Research Association
Copper Development Assoc., London
Firth-Sterling Steel Company
Greenfield Tap and Die Corporation
Landis Machine Company
Morse Twist Drill & Machine Company
National Twist Drill & Tool Company
Norton Company
Revere Copper and Brass Incorporated
Scovill Manufacturing Company
Tide Water Associated Oil Company
Westinghouse Electric & Mfg. Company

the following designations for standard tempers of annealed sheet and strip brass, in terms of the diameter of the average grain: 0.015, 0.025, 0.035, 0.050, 0.070 and 0.120 mm. Grain sizes usually are measured in millimeters at 75 diameters magnification.

Annealed tube tempers are indicated by grain size, in the same manner as for sheet and strip. Drawn tempers for tube products ordinarily are specified as follows: Quarter Hard—a reduction of from about 10 to 15 per cent; Half Hard—a reduction of from about 20 to 30 per cent; Hard—a reduction of more than 35 per cent. Another series of designations is employed for specifying the tempers of extruded and drawn, or rolled and drawn, rods: Annealed—corresponds approximately with 0.035 mm. annealed sheet; Quarter Hard—a final reduction of from 6 to 12 per cent, depending upon size; Drill Temper—a final reduction of about 20 to 25 per cent, depending on size; Extra Hard—any temper harder than drill temper. Ordinarily drill temper is the one most used for rod products.

COPPERS

Electrolytic tough pitch copper probably is used in greater quantity than all other forms of this metal, since its electrical conductivity is high and its working properties are, in general, very good. Its susceptibility to embrittlement when heated to elevated temperatures in a reducing atmosphere is a disadvantage in certain applications. The contained oxide in this form of copper often produces objectionable surface markings on parts requiring a high finish.

Lake copper is not refined electrolytically and frequently contains small amounts of silver and arsenic. It is of high purity and, if free from arsenic, has high electrical conductivity. Phosphor-deoxidized coppers are used where forming operations, such as flaring and spinning, might be affected by the copper-copper-oxide dispersion characteristic of electrolytic copper. The presence of arsenic appears to reduce any tendency toward scaling and arsenical coppers are of advantage where parts are to be exposed to relatively high temperatures.

Electrolytic copper can easily be drawn, stamped, formed, spun, brazed, soldered or welded. However, copper is relatively difficult to machine, its tenacity causing long chips and other machining disadvantages. By adding one per cent of lead to copper the machining properties are materially improved; but at the expense of ductility and malleability.

The fabricating properties of the deoxidized coppers are practically the same as those for electrolytic copper, except that the welding properties are somewhat better. High-phosphorous deoxidized coppers, containing in the neighborhood of 0.03 per cent phosphorous, show much lower electrical conductivity, but other characteristics are equal or superior to those of high-conductivity coppers.

BRASSES

The copper-zinc alloys, commonly known as the brasses, are perhaps the most widely used of the copper-base alloys. At times the term "brass" is confined to the copper-zinc alloys containing from 55 to 80 per cent copper and the higher-content group are referred to as "gilding metals" or commercial bronzes. The broader use of the term is to be preferred, and it is so applied in these pages. The copper-zinc alloys are best known for the ease with which they can be cast, extruded, forged, rolled, pressed, drawn, and machined. Chief among their characteristics are their ductility, malleability, high strength and good corrosion resistance. Useful wrought brasses of the straight copper-zinc series have a copper content extending from 55 to almost 100 per cent and the range of their properties is correspondingly great.

Zinc will dissolve in molten copper in all proportions if the mixture is stirred thoroughly; this condition of uniform solution may be obtained in the brass when solidified if the copper content is not less than about 63 per cent. Such a mixture, when cooled, consists of a uniform solid solution of zinc dissolved in copper, known in the industry as Alpha solid solution. These brasses combine good strength with considerable ductility when cold; brasses for making sheets, strips, wire and tube generally come within this class.

When the zinc content is increased, a second zinc-rich solution known as "Beta" solid solution becomes apparent and the resulting duplex structure is suitable for castings, or for hot-worked products. When cold the Beta crystals are hard and serve to increase the tensile strength of the brass while lowering its ductility. When hot the presence of the Beta constituent renders the brass plastic over a wide temperature range. By contrast, the Alpha brasses retain comparatively high strength in compression at high temperatures and considerable power is needed to hot-work them.

The tensile strength and other properties of brass depend to a large extent on the grain structure, which in turn is determined by whether the brass has been cast, forged, extruded, rolled, or annealed, and by the amount of subsequent cold working and annealing. In general, hot- or cold-working modifies the grain structure so as to increase the strength and hardness.

LEADED BRASSES

The addition of lead, in quantities up to 3 or 4 per cent, improves the machining characteristics of copper-zinc alloys. Cold ductility and malleability of the alloys are but slightly impaired when the lead content is low, but are reduced appreciably as the lead content is increased. Hot workability is, in general, materially lowered except for those alloys containing from 55 to 62 per cent copper. Most of the alloys having a high lead content are designed specifically for machining purposes; alloys with low and intermediate lead percentages are the result of compromises between machineability and workability properties. Such properties as strength, hardness, corrosion resistance, melting point, color, conductivity, coefficient of expansion and specific gravity are for most practical purposes not altered appreciably by the presence of lead.

Lead, being almost insoluble in brass, separates in small isolated globules and when the brass is machined the turnings are caused to break off short, thus freeing themselves readily from the tool. Work-hardening, induced by the final drawing of a free-cutting brass rod, further promotes machineability.

It is claimed that from two and a

Standard Temper Designations for Rolled Sheet and Strip

Standard Temper	Nominal Reduction B & S Gage No.	Approximate Percentage Reduction
Quarter Hard.....	1	10.9
Half Hard.....	2	20.7
Three-Quarter Hard.	3	29.4
Hard.....	4	37.1
Extra Hard.....	6	50.0
Spring.....	8	60.5
Extra Spring.....	10	68.7

These commonly used temper designations for rolled sheet and strip brasses also apply to rolled sheet and strip coppers and bronzes. Other designations are used for annealed sheet and strip, and for all of these metals when supplied in other forms

Forms in Which Copper Alloys Commonly Are Available

DESIGNATION	DEFINITION OF TERM
Plate	Applied to wide, flat pieces of relatively heavy gage whether produced by hot or cold rolling and regardless of the final temper or surface finish. There is no clear-cut distinction between plate and sheet.
Sheet	Individual flat pieces produced on sheet or strip rolls, usually of wide widths and thin gages.
Strip	Sheet metal cut in relatively narrow widths and furnished in both straight lengths and coils.
Flat Wire	Narrow flat metal rolled to finished widths, rather than sheared to width from sheet stock.
Rod	Material of simple section (round, half-round, oval, half-oval, square, hexagonal and octagonal) produced by extrusion and drawing, or rolling and drawing, where the finished product is shipped in straight pieces.
Bar	Often used interchangeably with the term "rod" but is generally applied to rectangular shapes in the brass industry.
Wire	Material finished by drawing through a die and may be of any simple cross section, but is furnished in coils, or is spooled or reeled.
Tube	Applied to any hollow section, regardless of shape.
Extruded Shape	Applied to sections of relatively complex shape produced by extrusion and straightening.
Drawn Shape	Produced by cold drawing strips or bars through a die or series of dies. Usually can be made in smaller sizes and thinner sections than can extruded shapes. A variety of hollow sections can be made from tubes.

half to three times as much power is required to remove the same amount of stock when machining free-cutting steel as compared with free-cutting brass. When turning, the advantage in favor of brass is further increased by the much higher speeds that can be employed; even when using form tools. Although lead does not improve the hot-stamping properties of brass, it is usual for this element to be present to the extent of up to 2 per cent in brass forgings so that they can be machined readily.

SPECIAL BRASSES

Corrosion resistance, strength, ductility, weldability and other properties often can be improved when elements other than lead are added to various base brasses. In general, the properties of such special brasses vary with the copper content in much the same manner as the straight copper-zinc alloys. The element most commonly added is tin, since it usually imparts added strength and hardness. In alloys, containing about 60 per cent copper, additions of tin markedly improve corrosion resistance. This improvement is the result of reduced dezincification, a type of attack to which such alloys are prone.

Iron reduces grain size for a given annealing treatment. However, it reduces ductility markedly and makes it difficult to control temper in the "Alpha" brasses accurately. It is seldom used except in such strong hot-working alloys as manganese bronze. Aluminum adds materially in resistance to tarnishing as well as to oxidation at moderately elevated temperatures. In addition it prevents impingement type of corrosion attack.

CORROSION RESISTANCE

All types of copper, in common with the alloys of copper, are highly resistant to most corrosive media. The degree of resistance of the alloys varies considerably, but the types of copper listed show almost the same high anti-corrosion properties. Polished copper, when exposed to clean dry atmospheres, may acquire an invisible protective film of cuprous oxide which increases the resistance of the copper to subsequent attack by industrial or contaminated atmospheres; development of such a film may be accelerated by heating at low temperatures of about 300 F.

The exposure of polished copper to industrial atmospheres, particularly those having traces of sulphides, results in tarnishing. Under these conditions the red color of copper, progressively changes through a series of reddish green and blue tints to a dull black, typical of cupric sulphide. The rapidity of this tarnishing depends largely upon the sulphur content and humidity of the atmosphere, and upon the presence or absence of a protective oxide film. A thin coating of some greasy substance may be applied to protect products from tarnishing. Copper lends itself to treatment by various solutions, particularly those of the sulphide type, when the production of definite color films on small articles is required. The resultant color may be obtained for long periods when protected by such means as lacquering.

Generalizations about corrosion are dangerous because of the variable factors encountered in practice. Each particular set of conditions should be considered individually. In general, copper can be used with dilute acids, caustic alkalis, and sea water; but should be protected from almost all oxidizing agents. Certain metallic salts in solutions of nonoxidizing acids frequently induce rapid corrosive action.

Brasses of higher copper content have higher resistance to many forms of corrosion than have those of lower copper content, such as those containing a Beta constituent. The optimum copper content seems to be about 85 per cent. On the other hand, resistance to attack by sulphur and sulphur compounds is more or less proportional to the zinc content. While copper-zinc alloys have been largely used on account of their rust-free properties, efforts have been made to improve their resistance to certain forms of corrosion by the addition of small amounts of other metals. Usually the effect of these additions is slight.

SHAPES AND FORGINGS

Extruded shapes are made by forcing metal billets, previously heated to a semi-plastic state, through a hardened steel die of the desired form. Being wrought, such shapes are characterized by their strong, homogeneous structure and smooth surfaces. Often machining can be reduced by employing these preformed shapes instead of castings or unformed stock. They are necessarily confined to a constant cross-section throughout their length. Hollow sections can be produced only in certain cases by drawing open extruded sections through steel dies. On the other hand tube stock frequently can be drawn through a series of dies to produce hollow sections of special shape. The physical properties of such drawn shapes usually are somewhat higher than those of plain extruded forms because of the additional cold-working imposed on the material.

Where the product includes metal parts of complicated, irregular designs, the use of hot-pressed parts or pressure die castings made from copper-zinc alloys frequently offers advantages from the standpoint of reduction in machining difficulties and uniformity of product. Frequently it is necessary only to thread, or drill and tap, such parts before final use.

PHYSICAL AND FABRICATION CHARACTERISTICS OF

COPPERS AND COPPER-ZINC ALLOYS Commonly Used Trade Names	Alloy No. (A.S.T.M. Spec. B 36 — 38 T)	APPROXIMATE CHEMICAL COMPOSITION (Per Cent)					APPROXIMATE TENSILE STRENGTH (1,000 Lb. per Sq. In.)				APPROXIMATE YIELD POINT (‡) (1,000 Lb. per Sq. In.)			
							Sheet Stock (Commercial)		Rod Stock (Commercial)		Sheet Stock (Commercial)		Rod Stock (Commercial)	
		Copper (Cu)	Zinc (Zn)	Lead (Pb)	Tin (Sn)	Others	Hard (*)	Soft	Hard (*)	Soft	Hard (*)	Soft	Hard (*)	Soft
Copper — Electrolytic Tough Pitch	....	99.9	.....	.....	.....	.....	51.0	32.5	50.0	32.0	46.0	11.0	44.0	14.0
Copper — Oxygen Free	....	99.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Copper — Phosphorized, High Conductivity	....	99.9	.....	.....	.....	0.007 P	.....	.....	.....	.....	.....	.....	.....	.....
Copper — Phosphorized, Low Conductivity	....	99.9	.....	.....	.....	0.03 P	55.0	35.0	58.0	35.0	42.0	15.0	.....	14.0
Copper — Arsenical	....	99.7	.....	.....	.....	0.30 As	.....	.....	.....	.....	.....	.....	.....	.....
Copper — Leaded	....	99.0	.....	1.00	.....	.....	.....	.....	45.0	.....	.....	.....	.....	.....
Gilding Metal	1	95.0	5.0	.....	.....	.....	55.0	35.0	.....	.....	34.0	11.0	.....	.....
Commercial Bronze	2	90.0	10.0	.....	.....	.....	61.5	37.0	.....	.....	47.0	11.0	.....	.....
Rich Low Brass	3	85.0	15.0	.....	.....	.....	67.5	42.0	70.0	42.0	61.0	17.0	.....	.....
Low Brass	4	80.0	20.0	.....	.....	.....	72.5	43.0	70.0	45.0	.....	.....	.....	.....
Shell Head Brass	....	75.0	25.0	.....	.....	.....	78.0	47.0	.....	.....	.....	.....	.....	.....
Spring Brass	5	72.0	28.0	.....	.....	.....	76.0	47.0	.....	.....	35.0	.....	.....	.....
"Seventy-Thirty" Brass	6	70.0	30.0	.....	.....	.....	76.0	46.0	.....	.....	.....	.....	.....	.....
Spinning Brass	....	68.0	32.0	.....	.....	.....	75.0	46.0	.....	.....	50.0	.....	.....	.....
"Two-and-One" Brass	7	66.7	33.3	.....	.....	.....	73.0	46.0	.....	.....	.....	.....	.....	.....
Drawing Brass	8	65.0	35.0	.....	.....	.....	73.0	45.0	70.0	45.0	.....	.....	.....	12.0
Yellow Brass	....	63.0	37.0	.....	.....	.....	77.0	48.0	70.0	50.0	.....	.....	.....	.....
Muntz Metal	....	60.0	40.0	.....	.....	.....	80.0	57.0	70.0	61.0	.....	19.0	.....	.....
Leaded Commercial Bronze	....	88.5	10.0	1.50	.....	.....	.....	.....	60.0	35.0	.....	.....	.....	.....
Hardware Bronze	....	85.0	13.25	1.75	.....	.....	.....	.....	60.0	.....	.....	.....	.....	.....
Leaded Red Brass	....	78.5	20.0	1.50	.....	.....	.....	.....	60.0	40.0	.....	.....	.....	.....
Leaded Brass	....	69.0	29.5	1.50	.....	.....	.....	.....	65.0	45.0	.....	.....	33.0	.....
Bearing Brass	....	67.0	29.0	4.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tube Brass	....	66.5	33.0	0.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Free Cutting Tube Brass	....	65.5	32.75	1.75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stamping Brass	....	65.0	34.7	0.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Leaded High Brass	....	65.0	33.5	1.50	.....	.....	72.0	45.0	.....	.....	.....	.....	.....	.....
Butt Brass	....	64.0	35.0	1.00	.....	.....	72.0	45.0	70.0	45.0	.....	.....	.....	.....
Engravers' Brass	....	63.5	34.5	2.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Free Cutting Brass	....	62.0	35.0	3.00	.....	.....	.....	.....	62.0	47.0	.....	.....	45.0	27.0
Clock Brass	....	61.5	37.0	1.50	.....	.....	80.0	45.0	.....	.....	.....	.....	.....	.....
Forging Brass	....	60.0	38.0	2.00	.....	.....	.....	.....	70.0	50.0	.....	.....	30.0	21.0
Architectural Bronze (Typical)	....	58.0	39.0	3.00	.....	.....	70.0	50.0	.....	.....	.....	.....	.....	.....
Admiralty Brass	....	71.0	28.0	.....	1.00	.....	78.0	45.0	.....	.....	.....	.....	.....	.....
Naval Brass	....	60.0	39.25	.....	0.75	.....	80.0	54.0	62.0	54.0	.....	24.0	55.0	24.0
Leaded Naval Brass	....	60.0	37.75	1.50	0.75	.....	.....	.....	.....	.....	.....	.....	.....	.....
Die Casting Brass	....	60.0	37.75	1.00	1.00	0.10 Al 0.15 Si	.....	.....	55.0	.....	.....	.....	35.0	.....

All of the figures shown are subject to manufacturing limitations which may alter the values; Note (*): For some alloys the figures given are for a temper slightly different from that commonly known as "HARD;" Note (‡): Yield point taken as the load producing an extension under stress of 0.50 per cent.

TYPICAL COPPERS AND COPPER-ZINC ALLOYS

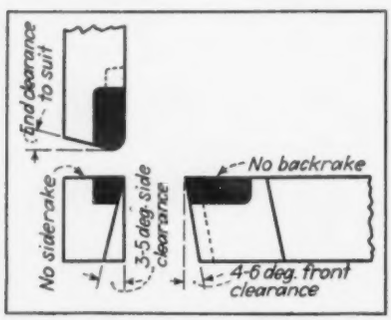
APPROXIMATE ELONGATION (Per Cent in 2-In.)				Young's Modulus of Elasticity (Lb. per Sq. In. X 10 – 6) (*) Hard	Average Linear (†) Coefficient of Expansion X 10⁻⁶	Density (Lb. per Cu. In.)	Melting Point (Degrees F.)	Electrical Conductivity (Per Cent I.A.C.S. at 20 C.)	Thermal Conductivity (Cal. per Sq. Cm. per Sec. per Degree C. at 20 Deg. C.)	ROCKWELL "B" HARDNESS NUMBER (100 Kg. Load on 1/16 In. Ball)				Relative Suitability for Being Worked		Best Temperature for Hot Working (*) (Degrees F.)	RELATIVE SUITABILITY FOR BEING WELDED				Relative Machinability
Sheet Stock (Commercial)		Rod Stock (Commercial)								Sheet Stock (Commercial)		Rod Stock (Commercial)									
Hard (*)	Soft	Hard (*)	Soft							Hard (*)	Soft	Hard (*)	Soft	Cold	Hot		Gas	Carbon Arc	Metallic Arc	Resistance	
4	37	18	38	16.0	17.7	0.322	1981	100.0	0.923	58	Too Soft	....	Too Soft	A	A	1400–1600	D	C	B	D	20
....	....	....	....	16.0	17.7	0.323	1981	100.0	0.923	....	....	....	....	A	A	1400–1600	C	B	B	D	20
....	....	....	....	16.0	17.7	0.323	1981	100.0	0.923	....	....	....	....	A	A	1400–1600	C	B	B	D	20
5	35	15	38	16.0	17.7	0.323	1981	80.0	0.770	61	Too Soft	....	Too Soft	A	A	1400–1600	C	B	B	D	20
....	....	....	....	16.0	17.7	0.323	1981	45–80	.....	....	....	....	....	A	A	1400–1600	C	B	B	C	20
....	....	....	....	.....	.....	0.323	1981	.....	.....	....	....	....	....	B	B	1400–1550	D	C	C	D	80
5	38	....	....	15.0	18.1	0.320	1949	54.6	0.576	62	Too Soft	....	Too Soft	A	A	1400–1600	C	B	B	D	20
3	40	....	....	15.0	18.2	0.318	1913	40.9	0.446	70	1	....	....	A	A	1400–1600	B	B	C	D	20
4	43	17.5	45	15.0	18.7	0.316	1877	37.0	0.380	76	10	74	Too Soft	A	A	1450–1650	B	B	C	D	30
4	50	15	50	15.0	19.1	0.313	1832	32.5	0.335	80	11	....	....	A	B	1500–1600	B	C	D	D	30
5	52	....	....	.....	19.6	0.310	1796	30.0	0.310	83	5	....	....	A	C	1450–1550	B	C	D	D	30
4	55	....	....	15.0	19.8	0.309	1769	28.6	0.295	83	20	....	....	....	....	.....	...	...	...	...	...
4	55	....	....	15.0	19.9	0.308	1750	27.6	0.290	83	....	....	....	A	C	1400–1500	B	C	D	C	30
5	55	....	....	15.0	20.0	0.307	1733	27.3	0.289	83	22	....	....	A	C	1400–1500	B	C	D	C	30
5	52	....	....	15.0	20.1	0.306	1720	25.9	0.287	80	20	....	....	A	C	1400–1500	B	C	D	C	30
5	50	15	50	14.0	20.2	0.306	1706	26.8	0.285	80	30	....	....	....	....	.....	...	...	...	...	...
4	50	12	50	14.0	20.5	0.305	1688	26.0	0.285	80	....	....	....	B	B	1300–1400	B	C	D	B	40
9.5	48	15	50	12.8	20.8	0.303	1660	28.6	0.300	87	42	84	37	C	A	1150–1300	B	C	D	B	40
....	....	8	30	15.0	18.3	0.319	1900	40.5	0.432	....	....	58	....	B	B	1400–1500	C	C	C	D	90
....	....	10	....	.....	.....	0.317	1877	.....	.....	....	....	....	....	....	....	.....	...	...	...	...	...
....	....	10	35	.....	19.2	0.314	1814	28.9	.....	....	....	....	....	....	....	.....	...	...	...	...	...
....	....	10	34	.....	20.0	0.309	1742	27.6	.....	....	....	....	....	....	....	.....	...	...	...	...	...
....	....	....	....	.....	.....	0.310	1720	.....	.....	....	....	....	....	C	D	.....	C	D	C	D	100
....	....	....	....	.....	.....	0.307	1720	.....	.....	....	....	....	....	A	D	.....	B	C	C	D	60
....	....	....	....	.....	.....	0.308	1710	.....	.....	....	....	....	....	C	D	.....	C	C	C	D	80
....	....	....	....	.....	.....	0.305	1700	.....	.....	....	....	....	....	B	D	.....	B	C	C	C	50
5	60	....	....	15.0	.....	0.306	1700	.....	.....	80	15	....	....	B	D	.....	B	C	C	D	70
5	60	4	40	15.0	.....	.....	1693	.....	.....	80	15	....	....	....	....	.....	...	...	...	...	...
....	....	....	....	.....	.....	0.307	1690	.....	.....	....	....	....	....	C	C	1300–1400	C	C	C	D	90
....	....	10	40	15.0	20.4	0.307	1625	25.0	0.258	....	....	77	16	D	B	1300–1400	C	D	D	D	100
4	40	....	....	.....	.....	.....	1666	.....	.....	87	13	87	13	....	....	.....	...	...	...	...	...
....	....	10	45	.....	.....	0.305	1630	26.5	0.258	....	....	....	....	D	A	1250–1550	C	D	D	D	80
....	....	10	20	.....	.....	0.306	1623	.....	.....	....	....	....	....	D	A	1200–1300	C	D	D	D	90
5	60	....	....	15.0	20.2	0.308	1720	24.7	0.263	....	....	....	....	A	C	1150–1250	B	B	D	C	30
5	45	25	45	15.0	21.1	0.304	1630	24.9	0.279	87	45	75	....	C	A	1200–1350	B	C	D	B	30
....	....	....	....	.....	.....	0.305	1620	.....	.....	....	....	....	....	D	B	1200–1350	C	C	D	D	70
....	....	8	....	.....	.....	.....	.....	.....	.....	....	....	....	....	....	....	.....	...	...	...	...	...

Note (†): Average linear coefficient per degree Centigrade from 25 to 300 C. Tests on rod. Scientific Paper No. 410, U. S. Bureau of Standards. Relative fabrication characteristics are indicated as follows: A — Excellent, B — Good, C — Fair, D — Poor.

OPERATIONS ON COPPERS AND BRASSES

The various coppers and copper-zinc alloys generally are relatively easy to fabricate. Copper and the straight brasses containing more than about 62 per cent copper can be cold worked to a very considerable degree. Those alloys that contain from 58 to 63 and from 85 to 100 per cent copper may be extensively hot worked.

The more machinable of the straight copper-zinc alloys are those having from 58 to 63 per cent copper; machinability increases as the copper content decreases. A lead bearing copper or brass usually is



Free-cutting brasses are best turned with a tool having zero side and back rake. Modifications of this carbide-tipped tool are widely used by brass fabricators

used where good machining characteristics are essential. Workability is impaired when the lead content is high and compromises must be made where the product is to be both hot or cold worked and machined.

HOT WORKING

Copper can be rolled, extruded or forged after preheating to temperatures ranging from 1,100 to 1,650 F. To avoid oxidation of grain boundaries, copper should not be heated above about 1,800 F. At no time should it be heated to high temperatures in a reducing atmosphere, since reducing gases may react with the cuprous oxide to cause brittleness or induce "blisters" in subsequent working operations.

Alpha-Beta brasses contain from 58 to 60 per cent copper and are especially suitable for hot working. Standard specifications for brass forging rod as published by the American Society for Testing Materials (No. B15-18), require that such rod meet the following requirements as to chemical composition: copper, 58.5–61.5 per cent; lead, 1.5–2.5 per cent.; iron, not over 0.15 per cent; materials other than copper, lead and zinc, not over 0.35 per cent; zinc, remainder. The lead in this rod facilitates the machining of hot pressings or forgings.

Care in determining the size and shape of the blank when setting up for hot forging operations in coppers and brasses usually will be advantageous, particularly in the case of small pieces to be finished with one blow. When the pieces are not symmetrical the use of a blank which conforms roughly with the finished shape is to be recommended. Extruded bars sawed to length for forging frequently permit the making of forgings with minimum metal movement in the dies.

COLD WORKING

Most commercial wrought coppers and brasses have good elongation and reduction of area values when in an annealed condition, and so usually can be cold worked successfully. Impurities in the alloy frequently cause difficulties; both iron and lead tend to reduce the ductility of these metals. They can be cold rolled, drawn, pressed, spun or hammered easily, but where the total reduction is heavy it is advisable to anneal frequently.

The best deep drawing alloy in the copper-zinc group probably is a "cartridge brass" containing about 70 per cent copper and 30 per cent zinc, but copper-zinc alloys containing from 62½ to 67½ per cent copper and one per cent lead often are used as compromise materials where deep drawing operations must be performed on parts that later are to be machined. Such alloys can be bent to a 90 deg. angle safely either across or with the grain in some tempers.

Draw dies should be designed to work the metal thoroughly in all sections in order that the entire crystal structure may be broken down to the same extent during the operation. It is better to start with a relatively heavy shell and work the metal in around the sides, than it is to just work the ends of the shell. The more the metal can be worked between anneals, the more a complete breakdown of the crystal structure will be possible and the better will be the condition of the finished piece. Grains unevenly broken down promote uneven grain growth in annealing.

Other cold working operations frequently performed on these metals include swaging, upsetting or cold heading, cold forging, flattening to remove buckles and burrs, sizing by coining, bending, and shallow drawing or forming. Some of these result in very little plastic working of the material, while others build up considerable pressure and must be followed by annealing to relieve internal stresses.

Uneven working of the material during any of the cold working operations induce internal stresses which may give rise to a spontaneous cracking of brass products known as "season cracking." Internal strains caused by local annealing frequently produce the same results. Such cracks usually do not appear until the intercrystalline strength of the metal is reduced by some corrosive action, such as may occur in an atmosphere containing traces of ammonia. Some brasses are more prone to season cracking than others; those containing more than 80 per cent copper seldom develop such defects. Internal stresses that may cause season cracking frequently can be relieved by a heat treatment at about 480–520 F., well below the temperature needed to produce any softening effect, in which the parts are soaked for up to 1–1¼ hr.

ANNEALING

Cold worked coppers and brasses whose grain structure has been deformed must be annealed if it is necessary that the metal be returned to a soft condition for any reason. The minimum temperature at which the necessary softening occurs is influenced by the extent to which the cold working has been carried and by the presence of alloying elements. Both the time required to bring the material up to the required temperature and the time of soaking at this temperature have determining effects on the quality and extent of the anneal. Work-hardened copper of high purity may be partly softened at temperatures as low as 250 F. if maintained for long periods, but the minimum temperature ordinarily used for annealing copper is at least 490-500 F.

Regular annealing ordinarily is carried on at a temperature just above the recrystallization point for the alloy; the actual metal temperature may vary from 750 to 1,200 F. for the lower-copper brasses and from about

APPLICATIONS of TYPICAL COPPERS and COPPER-ZINC ALLOYS

COPPERS AND COPPER-ZINC ALLOYS	Forms Commonly Available							CHIEF CHARACTERISTICS	TYPICAL APPLICATIONS
Commonly Used Trade Names	Plate — Sheet — Strip	Wire	Rod — Bar	Tube	Extruded Shapes	Forgings — Hot Pressings	Pressure Die Castings		
Copper — Electrolytic Tough Pitch	●	●	●	●	●	●		High conductivity, good working qualities, susceptible to embrittlement at high temperature	Elec. conductors, rivets, nails, cotter pins, soldering irons, gaskets, radiator cores
Copper — Oxygen Free	●	●	●	●	●	●		High conductivity, good working qualities, not susceptible to embrittlement	Elec. conductors, water tubing, gasoline lines, radiators, heating and cooling tubes
Copper — Phosphorized, High Conductivity	●	●	●	●	●	●		High conductivity, good working qualities, not susceptible to embrittlement	Elec. conductors, water tubing, gasoline lines, radiators, heating and cooling tubes
Copper — Phosphorized, Low Conductivity	●	●	●	●	●	●		Lower conductivity, otherwise equal or superior to any high conductivity coppers	Water tubing, heating and cooling tubes, also spun, drawn or formed parts
Copper — Arsenical	●			●				High strength, resists heat and flaking	Heat exchanger, condenser and boiler tubes
Copper — Leaded			●					Free cutting	Screw machine products, torch tips
Copper — Silver Bearing (Typical)	●	●	●	●	●	●		Has high softening point	For tinning, without loss of strength after cold working
Gilding Metal	●	●	●	●		●		High ductility, reddish gold color, corrosion resistant	Drawn, spun and formed parts, forgings, primers, detonator fuse caps
Commercial Bronze	●	●	●	●		●		High ductility, corrosion resistant	Hardware, screw shells, forgings, screws, rivets, primer caps
Rich Low Brass (85% Red Brass)	●	●	●	●				Corrosion resistant, ductile	Plumbing pipe, hardware, fasteners, flexible hose, shells, eyelets, radiator cores
Low Brass (80% Red Brass)	●	●	●	●				Corrosion resistant, ductile	Clock dials, flexible hose, bellows, drawn and formed parts
" Shell Head " (Brazing) Brass	●	●	●					Easily brazed or soldered	Eyelets, springs, musical instruments, also drawn, spun and brazed parts
Spring Brass	●	●	●					Corrosion resistant	Turbine blades, springs, eyelets, drawn and spun parts
" Seventy-Thirty " (Cartridge) Brass	●	●	●	●				Can be deep drawn, has high ductility	Cartridges, musical instruments, eyelets springs, drawn and spun parts
Spinning (Eyelet) Brass	●							Can be deep drawn, has high ductility	Eyelets, springs, screw shells, fasteners, bead chain, deep drawn parts
" Two-and-One " (High) Brass	●	●	●	●				Can be deep drawn, has high ductility	Hardware, radiator tanks, also blanked, formed, spun and drawn parts
Drawing Brass	●							Good for ornamental applications	Lamp fixtures, automobile radiators
Yellow Brass		●	●					Particularly suitable for cold heading	Pins, rivets and screws
Muntz Metal (Yellow Metal)	●	●	●	●	●	●		Corrosion resistant, used for ship sheathing	Architectural trim, valve stems, condenser tubes, brazing rod
Leaded Commercial Bronze			●					Free machining	Hardware, screw machine products, forgings, pickling crates
Hardware Bronze			●					Free machining	
Leaded Red Brass			●					Free machining	Rivets
Leaded Brass			●					Free machining, can be drawn or formed	For special shapes where high lead content alloy is not suitable
Bearing Brass	●							Free machining, can be drawn moderately	Bushings, drawn and machined parts
Tube Brass				●					Plumbing fixtures, pump liners, windshield tubing, special shapes
Free Cutting Tube Brass				●				Free machining	Screw machine products
Stamping Brass	●								Stamped, drawn, formed parts
Leaded High Brass	●	●	●					Free machining, can be drawn and cold headed	Drawn parts that must be machined, screws, rivets
Butt Brass	●	●	●					Free machining	Hinges, threaded parts
Engravers' Brass	●							Free machining	Gears, clock and watch backs, engraved parts
Free Cutting Brass		●	●		●			Free machining can be cold worked	Hardware, screw machine products, pinions, gears, drawn parts
Clock Brass	●							Free machining, easily milled	Clock and meter parts, gears and pinions
Forging Brass			●		●	●		Free machining, can be hot worked	Forgings, tire valve stems
Architectural Bronze (Typical)	●		●		●	●		Free machining, strong and hard	Hinges, forgings, valve stems, lock bodies, extruded shapes
Admiralty Brass	●	●		●				Resistant to sea water corrosion	Ferrules, filter wire, tube sheets, condenser tubes
Naval Brass	●	●	●	●	●	●		Resistant to sea water corrosion	Marine hardware, propeller shafts, bolts, nuts, balls, forgings
Leaded Naval Brass			●			●		Can be hot worked	Valve stems, screw machine products, forgings
Die Casting Brass							●	Suitable for pressure die casting	Pressure die cast parts

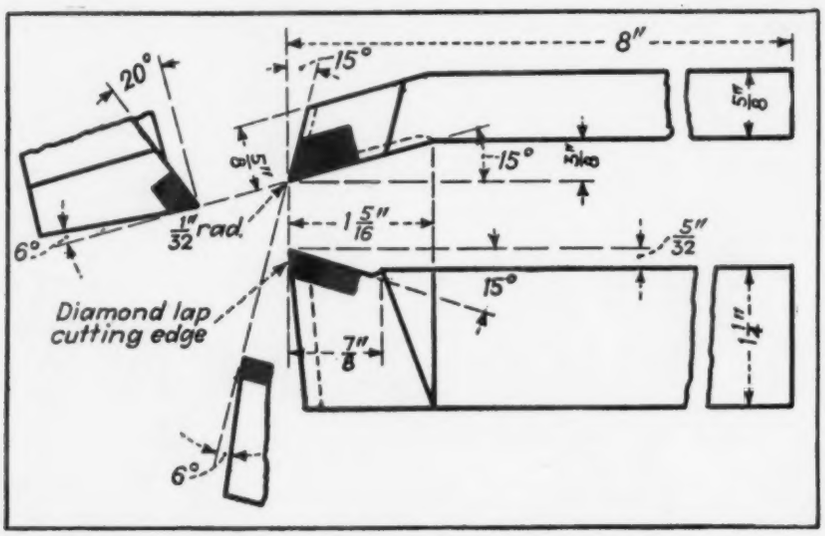
800 to 1,150 F. for those with higher copper content. Where copper content is less than about 65 per cent an excessive amount of the relatively hard Beta constituent may be retained unless the metal is allowed to cool slowly after annealing; such alloys never should be quenched. The high brasses, however, may be cooled slowly or rapidly without effect on the quality or properties of the metal.

Over-annealed brasses, which will contain large crystals, are very apt to give rise to an "orange peel" effect upon further cold working. Annealed grain size ordinarily must be held to 0.030–0.045 mm. to avoid the appearance of this defect. Some fabricators anneal to a definite grain size, rather than to a given temperature-time combination, because of the variables which affect the determination of a correct annealing temperature. Laboratory control of annealing operations is considered essential for proper control of grain size when cold working and annealing any of the brasses.

Flame or local annealing sometimes is used prior to second forming operations where one section of the part must be kept hard. In such cases, heating machines employing local-heating burners, and frequently arranged with conveying apparatus to carry the parts through the heating zone, can be used to advantage. Local annealing also can be done economically in molten salt baths. Grain size control is of particular importance when employing local annealing.

It is generally accepted that the use of a coarse grained metal will result in a rough surface on a drawn or formed part. The grain condition that is of most importance is that which is developed prior to the cold forming operation, not that secured by annealing after forming. In other words, a finish anneal at a low temperature does not necessarily produce a surface that can be polished readily; the grain size developed prior to the last forming operation may have been so coarse that a rough surface resulted from the operation.

The effect of improper annealing early in a sequence of operations often may be corrected by a series of proper low temperature anneals and intermediate cold working operations. Similarly, the surface of a piece of metal may be ruined by a single annealing operation conducted at too high a temperature late in the series of annealing and cold working operations. Care must be used in all annealing operations on fabricated articles which are to receive subsequent cold drawing or forming operations. In general, it is desirable to keep annealing temperatures as low as possible consistent with the requirements of the succeeding cold working operations. Where these requirements are such that the best surface conditions cannot be obtained, a compromise must be made between the ductility of the metal and final surface appearance.



This tipped tool is particularly adapted for turning and facing operations on coppers. It can be made straight or bent, as shown

MACHINING

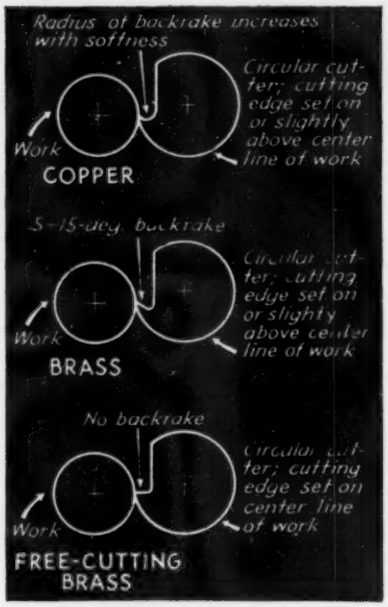
There is no ready means for accurately comparing the machinability of metals, nor can definite recommendations be given except when all of the variable factors are known. In general, the machinability of coppers and brasses is more dependent upon composition than on mechanical properties. Usually, it improves with decreasing amounts of copper and increasing amounts of lead, but is adversely affected by increasing amounts of other elements. These alloys can be classified roughly, in the increasing order of difficulty to machine, about as follows: (1) free-cutting brasses which include some element, usually lead, that improves the machining qualities, (2) the straight copper-zinc brasses, (3) the coppers.

Under some conditions, electrolytic tough pitch copper has slightly better machining qualities than do the deoxidized coppers. All of the non-leaded brasses and coppers are more difficult to machine than any of the leaded brasses; it has been estimated that more than 90 per cent of the machining operations in brass fabricating shops are performed on leaded brasses. Hard tempers in these alloys are easier to machine than are the softer grades. Copper and high-copper brasses have a tendency to build up on the tip of the cutting tool and rub off, instead of cut, particularly in the softer tempers.

TURNING

It is usual to turn free-cutting leaded brass at the maximum spindle speed of the lathe or screw machine, providing that required tolerances and finish can be attained at these speeds and that some other operation being performed at the same time, such as drilling, is not adversely affected. For short runs some savings may be obtained by using carbon steel tools, but usually high speed steel tools are used on average jobs and carbide-tipped tools are applied on long-run jobs where tool wear is a factor. Frequently carbide-tipped tools will show as much as five to six times the life between grinds than can be expected when using high-speed steel tools on any of the brasses; there usually is the same relation between high-speed steel tools and those made from carbon steels.

Leaded brasses regularly are turned at from 450–600 ft. per min. in screw machines using both box and form tools. These tools usually are ground with zero top or back rake, 0–5 deg. side rake and about 6 deg. front clearance. Turning tools for non-leaded brasses can be given a top rake of 5–7.5 deg. and a front clearance of 6–10 deg. Those used for the coppers are made with a top rake of 15–20 deg., a side rake of 20–30 deg. and a front clearance of 10–15 deg. Copper usually is turned at about 125 ft. per min. when using


Radius of backrake increases with softness
Circular cutter; cutting edge set on or slightly above center line of work
Work
COPPER
5–15-deg. backrake
Circular cutter; cutting edge set on or slightly above center line of work
Work
BRASS
No backrake
Circular cutter; cutting edge set on center line of work
Work
FREE-CUTTING BRASS

Circular tools for screw-machine work function best when ground with the back rake shown for each of the three group of alloys indicated

high speed steel tools. Turning speeds are subject to considerable variation with changes in conditions; for instance, a 55-in. diameter copper commutator has been turned to 3,450 ft. per min. with a 0.010 in. depth of cut when using a Carboloy-tipped tool.

Knurling and thread rolling operations ordinarily are considered together, since they both are operations that displace metal under pressure and differ from strictly cutting operations. The highly leaded brasses are less suited for these operations than are the semi-leaded or straight copper-zinc alloys, but by using a "quarter hard" instead of a "drill temper" free-cutting brass rod, the majority of thread rolling and knurling operations can be performed satisfactorily.

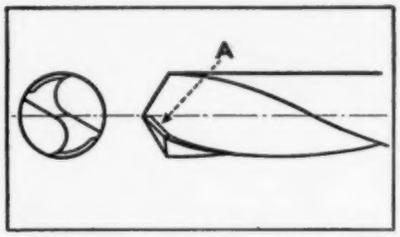
DRILLING

The drilling of coppers, straight brasses and leaded brasses is best done with high-speed steel "brass drills" made specially for this work and stocked by most drill manufacturers. Such drills ordinarily have a helix angle of about 22 deg., wider flutes than are used for ordinary drills, polished flutes, and a thin web. Point clearance angles for copper and the softer brasses usually are made 10–15 deg.; a 15-deg. point clearance angle is recommended for leaded brasses. Included point angles suggested are 100 deg. for copper and straight brass, and 118–125 deg. for free-cutting brass.

The helix angle of 22 deg., which is smaller than that used for standard twist drills, decreases the rake angle of the drill to a value usually satisfactory for most brass work. However, when heavy feeds are to be used the cutting edges frequently are ground off flat, as shown in the accompanying sketch, to provide a zero rake angle and prevent the drill from pulling into the work. Special brass drills having a helix angle of only 10 deg. are available for those screw machine jobs requiring the drilling of relatively deep holes. The slower helix and polished flutes of these drills seem to slide the chips out of the hole more readily.

Many factors affect the speed and feed best suited for a given drilling operation. Usually, high-speed steel drills can be operated at 100–150 ft. per min. in copper; 70–125 ft. per min. in straight brass; and 200–300 ft. per min. in leaded brasses. Carbon steel drills are run at about 40–50 per cent of these speeds. Feeds two to three times those used for soft steel are common in brass work; light feeds are necessary for smooth, accurate holes.

Copper, because of its gummy nature, usually is drilled with a light feed and a lubricant of soluble oil. Most drilling in brass is done dry, but the following lubricants are useful for certain operations, particularly for precision and deep-hole drilling: (a) straight soluble oil, (b) straight paraffin oil, (c) a paraffin oil containing 10 per cent lard oil, (d) a mixture of ⅓ kerosene and 2/3 lard oil, (e) a mixture of ½ kerosene and ½ soluble oil, and (f) some sulphonated oils.



Brass drills, frequently are ground flat on the cutting edges, as at *A*, to reduce the cutting rake and prevent the drill from "hogging in"

REAMING

In general, the same conditions hold when reaming as when drilling copper and brass. Reamers ordinarily used are the same as those specified for steel, except that the clearance angle is increased to 7–8 deg. The rake angle should be very small, preferably zero, and usually is obtained by using straight-fluted reamers with radial teeth. Left-hand spiral, right-hand cut reamers have been found to give good results in free-cutting brasses. Reamers for brass often are given a special heat-treatment to increase their surface hardness and lengthen their useful life. A reaming speed of 70–80 ft. per min. is recommended for copper and 100–150 ft. per min. for free-cutting brass when using high speed steel reamers. Carbon steel reamers are run at 30–40 ft. per min. in copper and at 70–80 ft. per min. in brass. Feeds should be two to three times that used for drills of the same diameter. Soluble oil can be used when reaming copper, and a mixture of lard oil and kerosene can be used for brass.

It is best to reduce the speeds and feeds of counterbores, as compared with speeds and feeds for drills, when machining brass. The amount of reduction will depend on the size and nature of the cut and work. Ordinary free-cutting brass can be counterbored at 180 ft. per min., with feeds of 0.004 in. per rev. for ¼ to ⅜ in. counterbores to 0.010 in. per rev. for 2-in. diameter counterbores. These feeds are suitable for average chip widths; wider-than-average chips require less feed.

TAPPING

The problem of cutting internal threads with taps in copper and brass involves many variables, any of which affect the quality of the work done and the time required to do it. Proper speeds are essential for successful tapping, as are properly ground taps and correctly applied tapping equipment. Suggested average speeds for tapping copper are 45–50 ft. per min. with carbon steel taps, and 90–100 ft. per min. with regular high speed steel taps. Blind holes in copper should be tapped at 50–60 ft. per min. with high speed steel taps. Brass can be tapped at as high as 200–220 ft. per min. with high speed steel taps lubricated with a mixture of lard oil and kerosene.

Cutting faces of taps for brass are usually radial; however, a rake or hook of 3–5 deg. is sometimes desirable. Copper often taps best when the faces of the tap have a hook of up to 20 deg. The tap drill should leave material for about 60–70 per cent depth of thread in copper and 75–80 per cent depth of thread in brass when the hole is at least as deep as the diameter of the tap. A 100 per cent thread is only about 5

per cent stronger than a 75 per cent thread, but it requires three times the power to tap.

External threading with dies involves consideration of practically the same variables as those which affect tapping operations. Ordinarily, dies for free-cutting brass are ground with radial faces, while those for copper and high-copper brasses should have undercut faces. Threading speeds ordinarily recommended for dies are the same as those for taps. There are three general classifications of threads cut with dies which affect the grinding of chasers for die heads, these are: (1) straight threads cut without a lead-screw or positive lead attachment, (2) straight threads cut with the die head operating in connection with a lead-screw, and (3) tapered threads cut with or without a taper attachment.

MILLING

Many variables affect milling operations, but in general they can be related to the finish desired. The clearance behind the cutting edge on profile-type milling cutters for copper and brass must be sufficient to avoid rubbing; but should not be so great as to permit the cutter to "hog in" to the work. Too much clearance will weaken the cutting edge. The land should be kept at 1/32 to 1/16 in. in width, depending on the size of the cutter.

For finish cuts in copper, a rake angle of 10–15 deg., a clearance angle of 12–17 deg. for cutters more than 3-in. in diameter and 8–9 deg. for smaller cutters, and a speed of 100–200 ft. per min. can be used in most cases. Similar cuts in brass require a rake angle of 0–10 deg., a clearance angle of 10–12 deg. for large cutters and 6–7.5 deg. for cutters smaller than 3-in., and a speed of 150–200 ft. per min. The amount of feed per revolution will depend on the finish desired. The use of a coolant is suggested.

GRINDING

Because of the wide range of physical properties developed in fabrication and treatment of coppers and copper-zinc alloys a variety of problems must be considered when grinding these metals. Where the copper content is high, characteristics of ductility and malleability are at their maximum and chips are not readily formed in grinding. The metal tends to flow rather than form clearly defined chips. This plastic flow increases the metal load on the wheel face, interfering with the cutting action of the abrasive grains.

Materials which flow and load the wheel ordinarily do not have sufficient tensile strength to break down the abrasive grain or unseat it from its bond. When the tensile strength and hardness are increased, by decreasing the copper percentage or by cold working, the grinding problem is simplified. Metals of high tensile strength, usually less ductile and harder, are ground best with fused aluminum oxide, while the more ductile metals require the use of silicon carbide abrasives. Both abrasives are used for the range of copper base alloys; either may be applied successfully for a few of the alloys.

Lapping operations now can be performed successfully on copper-base alloys. Early attempts to lap these metals, particularly the softer alloys, resulted in the impregnation of abrasive in the surface being lapped. This difficulty can be overcome by using a special fused aluminum oxide abrasive in a special vehicle. Polishing operations ordinarily are done with a hard wheel set up with glue and emery, or other abrasive. A rag wheel and tripoli is used for buffing, while coloring is done with a rag wheel and lime or red rouge.

CLEANING

There are two principle methods for cleaning coppers and copper-zinc alloys between fabricating operations. The first, liquid-vapor degreasing, is particularly satisfactory for removing oils and greases. This method will not remove buffing compounds and other cleaning methods must be employed where buffed parts require plating or lacquering.

Electrolytic cleaners are particularly applicable for cleaning copper and brass parts between intermediate operations and before final finishing. Acceptance of this method has been slow because of the first cost of the necessary equipment, but its use is spreading. In principle, it consists of treating the parts electrolytically in an alkaline bath.

Ordinary alkaline (caustic soda) cleaners are less expensive than vapor degreasing and are used wherever satisfactory. A water rinse must follow immersion in such a cleaner, or spots will appear on the work. Mechanical washers, frequently of the drum type, are used for applying alkaline cleaners whenever the nature of the work will permit and production quantities justify the installation.

Drawing compounds should be removed with a water rinse if the compound is of a soap-base type, or with a detergent bath if the compound has an oil base. The usual practice is to dip annealed copper and brass parts in a ten per cent solution of sulphuric acid before further working. In some cases an additional treatment of a solution of sulphuric acid and sodium dichromate is used as a "bright dip" following the sulphuric acid solution dip.

Oxides are removed from the surfaces of parts that are to be soldered by using a combination nitric-sulphuric acid dip. Large parts frequently are cleaned only on the surfaces to be soldered, but it is cheaper to clean small parts by submersion. This acid cleaner also is used for parts to be brazed; cleaning is more important for brazing than for soldering.

Parts to be lacquered usually are highly polished and they are cleaned by some combination of operations similar to the following: (1) dip in hot benzine, (2) dip in a hot so-

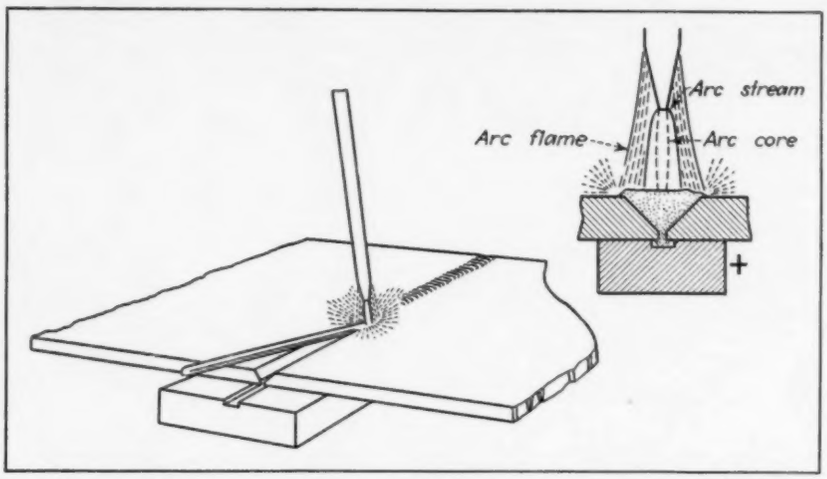
Suggested Wheels for Grinding Coppers and Brasses

LOW-STRENGTH COPPER ALLOYS

Operation	Abrasive Type	Abrasive Grit Size	Norton Grades	Carborundum Grades	Process	Wheel Speed Surf. Ft. Per Min.
Snagging	Silicon Carbide	16–36	N	H to J	Vitrified	5500–6000
Cylindrical	Silicon Carbide	36–60	L	N to P	Vitrified	5500–6000
Internal	Silicon Carbide	36–60	L	P to S	Vitrified	5500–6000
Surfacing	Silicon Carbide	24–36	H	R to T	Vitrified	4500–5000
Cut-Off	Silicon Carbide	24–36	W	6 to 8	Resinoid	10000–15000

HIGH-STRENGTH COPPER ALLOYS

Operation	Abrasive Type	Abrasive Grit Size	Norton Grades	Carborundum Grades	Process	Wheel Speed Surf. Ft. Per Min.
Snagging	Aluminum Oxide	16–36	N	H to J	Vitrified	5500–6000
Cylindrical	Aluminum Oxide	24–60	L	M to P	Vitrified	5500–6000
Internal	Aluminum Oxide	36–60	L	N to P	Vitrified	5500–6000
Surfacing	Aluminum Oxide	24–36	H	R to T	Vitrified	4500–5000
Cut-Off	Aluminum Oxide	24–36	W	6 to 8	Resinoid	10000–15000



When welding coppers and brasses with the electric carbon arc the welding rod should be laid in the groove and the arc struck from the rod, not from the plate. Arc length should be ¼ to 1 in. with voltages of 40 to 60 and a welding speed of at least 10 in. per min. for best results

lution of platers' soap, (3) rinse in clear hot water, (4) dip in a hot alkaline cleaner, (5) rinse in cold water, (6) rinse in a cold cyanide solution, (7) rinse in cold water, (8) finish in two separate hot water rinses. Care must be used in rinsing after the alkaline cleaner to insure against any of the cleaner being left in blind holes or depressions. In cases where adhesion of enamel is important a dichromate or ferric chloride etch is added to the above sequence following the cold water rinse after the alkaline cleaner. The hot benzine dip can be eliminated in those cases where appearance is not a major requirement.

Different combinations of dips are used for coloring coppers and brasses. Most of these solutions contain sulphuric, nitric, or hydrochloric acids in combinations or in varying sequences. Solutions for producing various color effects on copper and brass, including brown, reddish bronze, blue and black tones, and various green effects, are well known to most brass workers.

SOFT SOLDERING

All of the coppers and brasses are capable of being joined by soft soldering with tin-lead alloys. For good soldering, the following rules should be followed: (1) the surfaces to be soldered must be cleaned, either chemically or by scraping, filing, or rubbing with sand or emery paper; (2) while soldering, the metal surfaces must be brought to a temperature above the solidus point of the solder; (3) the flux used should be molten at temperatures below the solidus point of the solder so that it will not be entrapped in the solder in the joint; (4) all traces of corrosive fluxes should be removed carefully after the joints have been made.

Joining by soft soldering may be performed by dipping the work, after cleaning and fluxing, in a bath of molten solder, or by the application of a stick or piece of solder direct to the heated work, or by flowing molten solder off of a hot soldering iron. When a higher strength than can be obtained with tin-lead solders is required, particularly at temperatures above 212 F., and where some shear strain is encountered, a solder containing 95 per cent tin and 5 per cent antimony often is used. Rosin is used as a flux when the joints are in such a position as to make washing to remove corrosive fluxes impracticle.

HARD SOLDERING

Hard soldering with a silver solder is essentially a brazing operation and is used where a high-strength joint is desired. A borax-type flux is employed and the operation is carried on at a higher temperature than that employed for soft soldering. Silver solders have a melting point ranging from 1,200 to 1,600 F. The strongest joints are made with small clearances, not over 0.003-0.004 in. for best results.

BRAZING

Brazing is a term applied to a process for joining metals with alloys of copper and zinc which melt at temperatures appreciably below the melting points of the metals to be joined. Clean and properly fitted joints are essential for proper bonding. The temperatures required for brazing will cause rapid oxidation of the surfaces of the joint if exposed to the air during the heating. The use of borax or boric acid fluxes will protect the surfaces against oxidation and dissolve any oxides that may form. Combinations of borax and boric acid are used extensively.

Heating of the joint for brazing can be by: (1) dipping into a bath of molten alloy, (2) use a torch, (3) insertion in a furnace, or (4) by electrical resistance. Selection of the brazing alloy depends upon several factors, of which the melting point of the alloy is important. Brass and nickel-silver brazing alloys will melt at about 1,600-1,700 F. while copper alloy welding rods have melting points ranging from about 1,600 to 2,250 F.

Brazed joints are much stronger than those made by the average soft-soldering process; in some cases the strength is only slightly less than that resulting from welding. One disadvantage of brazed joints, as compared with welded joints, is associated with the contact of materials of essentially different composition. This produces a tendency to preferential attack in the presence of certain corrosive liquids.

WELDING

The high thermal conductivity of copper and brasses, which for most purposes is one of the advantages of these metals, is from the point of view of welding a disadvantage. Heat is conducted away from the parts to be welded so rapidly that it is difficult to raise the temperature of the metal to the melting point. Forge welding can be performed only with difficulty owing to the formation of oxides during heating. Gas flame welding and electric carbon arc welding processes have been applied successfully to the welding of both coppers and brasses within recent years. Electric metallic arc welding also has some applications in joining certain brasses.

GAS WELDING

Oxy-acetylene welding probably is the most important welding process for general application to copper. Oxy-acetylene welds in any copper alloy with silicon bronze, phosphor bronze, deoxidized copper, or silicon copper rods are fusion welds; the base metal is melted simultaneously with the weld metal. Although lower in electrical conductivity than

commercial copper, deoxidized copper welding rod often is used for the oxy-acetylene welding of electrical conductors because it makes a sounder weld than an electrolytic copper rod. Where strong, ductile connections are required a silicon copper welding rod usually is employed.

Thin sheets of copper usually are welded in the forehand position as is done in welding steel, but for welding thick copper plates the torch is operated in a backhand position with the seam horizontal. Care should be taken in handling the flame so that the weld metal and adjacent base metal are not overheated by too long exposure to the intense heat of the inner cone. It is suggested that the length of rod required for that joint be prefluxed to prevent too frequent removal of the rod from the weld.

The brasses can be oxy-acetylene welded successfully provided steps are taken to stop volatilization of the zinc, which might otherwise leave blow holes in the metal. Loss of the zinc can be prevented by using a borax mixture flux and by cutting down the acetylene content of the flame until it is oxidizing in character. This type of flame will cause the formation of a coating of zinc oxide which protects the weld. The oxide film must be kept thick enough to prevent zinc vapors from bubbling through.

Filler-rods can be obtained for welding practically all of the brasses. These rods usually contain phosphorous or silicon for deoxidizing purposes. When welding brasses for decorative purposes it is best to use a rod of the same composition so that the weld will be of the same color as the surrounding material. The brass forming the weld is in an "as cast" condition and should be hammered to improve the grain structure and strength of the metal in the neighborhood of the weld. After welding, Muntz Metal should be hammered at a temperature just below the melting point; cartridge brass should be hammered cold. A final annealing is desirable after the hammering has been completed.

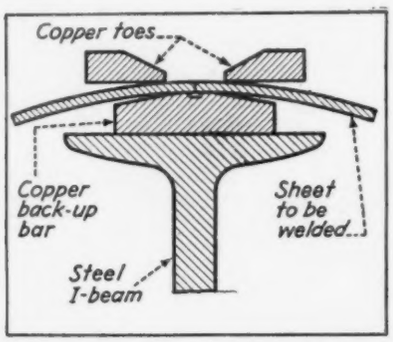
Copper Brass or Bronze Sheet Thickness, Inch	Carbon Diameter, Inch	Welding Rod Diameter, Inch	Current Amperes
1/16	1/4	1/8	125 to 225
1/8	1/4	1/8	175 to 350
1/4	3/8	1/4	250 to 500
3/8	3/8	3/8	350 to 600
1/2	7/16	1/2	600 to 800

Current variations for various thicknesses of copper when welding with the carbon arc are indicated

CARBON-ARC WELDING

The greatest use for high voltage carbon arc welding with phosphor bronze rods now is found in its application to copper. It is necessary to supply heat to the weld faster than it can be dissipated and a high welding speed is imperative to prevent the formation of objectionable oxides on electrolytic copper. A high voltage long arc is necessary to envelop the fused metals in a neutral atmosphere of carbon dioxide.

The welding rod used should melt at or below the melting point of copper and must stand the high temperature involved without oxidizing or losing any of its constituents. Phosphor bronze containing nominally 10 per cent tin, 0.25 per cent phosphorous, and the remainder copper, is suited for this work. The following welding procedure employ-



Successful welding of coppers and brasses depends, to a large extent, on the type of back-up bar or plate used. A typical set-up for carbon arc welding sheet metal is shown. If an automatic head is used, a metallic arc weld can be made in any type of material

ing this rod and the high voltage carbon arc is substantially the same for all metals welded by this process.

The plates, if more than 3/16 in. thick, should be beveled with a single V at an angle sufficient to allow the molten weld metal to reach the bottom of the V and, where possible, should be closely backed up with a comparatively light copper bar, leaving the bottom of the beveled edges about 1/16 in. open. Where this is impractical, the beveled edges can be butted tightly together and a weld made at sufficient speed to avoid melting completely through the joint; then, turning the plate over, it should be chipped out to sound metal and another light weld made. When plates are more than 1/4 in. thick it may be desirable to double bevel the edges and make welds on opposite sides.

The end of the welding rod should be laid in the groove and the arc struck from the rod, not from the plate. When the arc is struck from the end of the rod, a pool of bronze will form and protect the copper from deposits of carbon or surface burning. After the arc has been maintained on this pool for a sufficient time to allow the heat to penetrate the copper and bring it to the requisite temperature, the bronze will spread out and tin the copper. The arc then can be advanced along the seam.

The rod is held at only a slight angle above the surface of the plate, with the end down in the bottom of the V to prevent the hot weld metal from rolling ahead on the cold base metal. A welding rod size should be selected that will fill the V and provide sufficient reinforcement for the joint when an inch of rod is melted for an inch of weld. The carbon should be held directly over the joint and pointed straight down or inclined slightly back toward the completed weld.

A high enough current should be used on any given thickness of plate to obtain tinning of the initial pool of bronze within four or five seconds after the arc is struck. If the current value is lower than this there is a possibility that the weld metal or copper will be damaged before the operator is ready to advance along the seam. Any weld made slower than 10 in. per min. usually will show porous weld metal and, if the plate is electrolytic copper, minute specks of oxide may form adjacent to the weld.

When welding various grades of brass, including the copper-zinc alloys commonly known as commercial bronze, red brass and Muntz metal, essentially the same procedure is followed as when welding copper. However, when welding brass with the high-voltage carbon arc method, it is even more important that the maximum welding speed be maintained. The arc voltage should always exceed 40 volts; at time 60 volts may be used to advantage. These arc voltages call for an arc length of 1/2 to 1 in. Too short an arc or too slow travel along the weld results in porous weld metal which is evidenced by the appearance of gas pockets on the surface. In general, the conditions of the backing and assembly of the plates permit wide variations in the current used.

NEWS OF THE INDUSTRY

Officials Divided on Advisability of Mass Production of Airplanes

Many believe reduction in manufacturing costs would not justify "freezing" basic plane designs

WASHINGTON—If the federal government decides that its air force must be built up in a hurry to 9,000 planes or more, the aircraft industry is in a position to produce them. But before that can be done, the country's military authorities must make up their minds that if they want mass production of aircraft, they must be willing to "freeze" one or two desirable plane designs over a considerable period. All of which means that many of the planes coming off assembly lines would be obsolescent in design before they are completed because aircraft design is changing so fast.

When the President and the War Department speak of producing planes in large numbers, they are believed to be thinking in terms of "freezing" the design of one or two types. By insuring large orders for one type of plane, they thus will open the way for aircraft makers to invest in costly tooling programs. Orders for any particular type of plane to date have been so small that heavy investments in tools and dies have not been justified, so-called hand methods being used instead.

Aspects Being Studied

Not all of the high military officers of the government are understood to be in agreement on freezing aircraft design for an extended period. It is known that the far-reaching implications of the "freezing" program from a military standpoint are under thorough examination and a report on this is expected soon.

The job of putting the airplane industry on a higher-volume basis would not be too difficult. Many of the plants are operating on only a single shift, or in some cases two shifts, and an extra shift would be added. The most perplexing problem would be an adequate labor supply. If the industry launched a big program, it would draw skilled labor from other industries, particularly from the ranks of unemployed automobile workers. These new workers, though versed in metal-working or other crafts, would have to be trained in the special requirements of the aircraft industry. That would mean that production would be relatively slow in expanding and that labor's part of manufacturing expense would be high.

Little Demand for Equipment

Though the government may proceed within a month or two with its idea of mass production of planes, it would be a mistake to suppose that aircraft makers will immediately have to invest in large amounts of new machinery and equipment. As a matter of fact, aircraft engine plants are tooled up for considerably greater capacity than current production calls for. Production would have to be pushed up substantially before equipment buying on a large scale would be necessary.

Factory enlargement would first take place in plants fabricating the fuselage and other parts than the engine, and in plants assembling planes. The general impression is that the airplane industry is operating close to full capacity, but that is an exaggeration. To illustrate the point—one prominent company now has at work a force of 1,000 men, whereas only a few months ago 4,000 men were on its payrolls.

If the government should suddenly plunge into a big airplane program, it would not demand that aircraft plants push aside all commercial orders now on their books. Many factories are turning out planes for foreign governments, and naturally the United States government's orders would be given priority where necessary. The attitude of some government officials, however, is that orders from abroad help give American airplane plants the volume of production which they need and in that way contribute to low-cost manufacture.

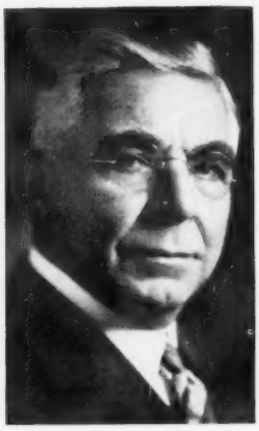
Profit, Incentive Schemes Blasted by Executives

WASHINGTON—Profit sharing and incentive taxation have been mentioned together in the public prints lately, but they are very much two different things. Profit sharing is just one of many things which the government could foster, encourage or enforce if it had the powerful leverage of incentive taxation to do it with. The roughest critics of incentive taxation have called it punitive power, which might be used for any objective: profit sharing, increased employment, support of government policy, the disemployment of women, propaganda in the press, or what have you. The Washington thermometer indicates that profit sharing might be all right for companies that want it, but incentive taxation is definitely not all right.

The heads of some estimable firms like Sears Roebuck, Procter & Gamble and Eastman Kodak, testifying before the Vandenberg Senate finance sub-committee, outlined their profit-sharing plans and approved of the principle. But a big majority of business tossed bricks at the whole scheme. Organized labor gave it nothing but abuse. Hearings will run on till about Dec. 15 or until the appropriation is all spent. Inquiry reveals but one instance where the sponsors of a futile investigation called a halt and put the money back in the "kitty."

This inquiry, however, is not regarded as entirely useless, even though it should taper off into oblivion as Washington now expects. It has served to bring to the attention of the public, employers, and labor a number of successful industrial relations programs based wholly or partly on the sharing of profits with workers. This publicity will cause managements to take these schemes apart to see how they work. Both employers and labor may find, as astute witnesses have testified, that profits cannot be shared unless they are first earned; therefore the plan is necessarily limited to successful companies. Employers will find that if labor shares profits, it will insist on sharing management.

B. F. FAIRLESS



W. A. IRVIN

J. L. PERRY

New Irvin Works of Carnegie-Illinois Opened by U. S. Steel Executives

PITTSBURGH—More than 1,000 leaders of American commerce and industry participated in the activities of the formal opening of the Irvin Works of the Carnegie-Illinois Steel Corp. Dec. 15.

Guests at the dedication of the new mill, which is named in honor of William A. Irvin, vice-chairman of the board of U. S. Steel, attended a luncheon at the plant as part of the opening ceremonies. In the evening the party enjoyed a reception and dinner at the William Penn Hotel. J. L. Perry, Carnegie-Illinois president, presided as toastmaster at the dinner.

Other U. S. Steel officials participating in the ceremonies included Benjamin F. Fairless, president; Myron C. Taylor, former chairman, and Edward R. Stettinius, present chairman of the board.

The Irvin Works is equipped to produce either hot or cold rolled strip or sheet, from 18 to 77 in. in width, in practically any desired finish, as well as tin plate and tin mill black plate. The plant is composed of three principal divisions: an 80-in. continuous hot strip mill, a cold reduced tin plate mill, and a cold reduced sheet and strip mill, complete with the necessary pickling, annealing and finishing facilities. The cold reduced tin plate division was the first to be completed, with all facilities ready for operation in March, 1938.

Slabs for the recently completed hot strip mill, which is nominally rated at 600,000 gross tons per year, are shipped from the Edgar Thomson works 6 miles away. To assure a steady supply of slabs, the Thomson plant has been expanded by the installation of a new 45x80-in. reversing-universal slab mill, capable of handling 45,000-lb. ingots.

The site of the new plant covers a total of 653 acres, with over 51 acres being under roof in the 17 buildings which comprise the mill. Over 4,000,000 cu. yd. of dirt and rock were removed in creating the plateau upon which the plant is situated, over 200 ft. above the level of the river.

Prentis Replaces Barnum As Standards Group Head

NEW YORK—Edmund A. Prentis, for the past three years vice-president of the American Standards Association, was elected president to succeed Dana D. Barnum at the Association's twentieth annual meeting recently. Also elected were: R. E. Zimmerman, vice-president United States Steel Corp., vice-president; F. M. Farmer, vice-president Electrical Testing Laboratories, Standards Council chairman; and R. P. Anderson, American Petroleum Institute, Standards Council Vice-chairman.

One of the highlights of the meeting was an address by William L. Batt, president SKF Industries and president of the International Management Conference, who was guest speaker at the gathering. Prior to Mr. Batt's address, Mr. Barnum welcomed six additional trade groups that have in the past 12 months become members of the association, bringing the total basic membership to 71 national trade associations, technical societies and departments of the Federal Government.

Exports of Machinery During October, 1938

	October 1938	September 1938	October 1937
Electrical machinery	$9,189,618	$7,299,055	$10,260,459
Power generating machinery except automotive and electric	1,185,543	913,622	1,533,364
Construction and conveying machinery	1,920,823	1,813,839	2,349,050
Mining, well and pumping machinery	4,582,379	4,915,233	5,619,140
Power driven, metal-working machinery	7,513,557	8,144,947	5,647,238
Other metal-working machinery	326,736	250,610	348,697
Textile machinery	565,109	338,863	1,291,253

Exports of Metal-Working Machinery During October, 1938

Engine lathes	180,853	395,204	392,572
Turret lathes	454,970	426,372	321,421
Other lathes	176,854	224,765	159,030
Vertical boring mills and chucking machines	126,763	330,760	149,717
Thread cutting and automatic screw machines	268,856	292,039	359,619
Knee and column type milling machines	232,360	230,445	332,049
Other milling machines	1,195,864	924,441	416,086
Gear-cutting machines	264,610	218,750	244,997
Vertical drilling machines	17,345	42,245	41,975
Radial drilling machines	54,765	9,881	13,146
Other drilling machines	154,502	236,253	132,463
Planers and shapers	184,634	282,446	77,277
Surface grinding machines	276,113	264,047	155,488
External cylindrical grinding machines	167,084	302,788	154,324
Internal grinding machines	483,403	227,059	405,375
Tool grinding, cutter grinding, and universal grinding machines	284,665	308,370	186,559
Other metal-grinding machines and parts	439,057	360,639	132,413
Sheet and plate metal-working machines and parts	539,211	693,492	275,686
Forging machinery and parts	241,627	812,251	269,696
Rolling mill machinery and parts	685,381	861,779	486,006
Foundry and molding equipment and parts	374,149	109,393	171,756
Other power-driven metal-working machinery and parts	710,491	591,528	769,583

Other Metal-Working Machinery

Pneumatic portable tools	95,547	93,938	109,928
Portable and hand and foot operated metal-working machines and parts	127,027	63,879	108,426
Chucks for machine tools	21,652	13,105	16,531
Milling cutters, machinery operated thread dies and taps and similar machinery operated metal cutting tools	44,533	43,030	42,938
Other metal-working machine tools	37,977	36,658	70,784

DETROIT LETTER

Assemblies will approximate 420,000 units in December, but may drop to 380,000 in January . . . Equipment market is dull, and few mechanical changes are seen for 1940 cars . . . Shipbuilding and appliance manufacturing face a poor year . . . Educational orders will mean little here

RUPERT LE GRAND
Detroit Editor, *American Machinist*

DETROIT—At first, car manufacturers privately estimated that assemblies in January would be 10-15 per cent lower than in December. But brisk new car sales and the difficulty of stocking dealers are still such bullish factors that the production drop is likely to be less than 10 per cent. For example, Chevrolet has scheduled 98,000 assemblies for January as compared with 105,000 in December. That is a loss of only 6.6 per cent. Ford recently went to 4,000 per day, and is said to be striving to reach 4,400. Chrysler divisions disclaim any intention of going to less than the present five-day week. Of course, these figures are still susceptible to downward revision if a sales drop should be noted after the first twenty days of this month, or if heavy winter sets in and affects sales later.

Production in December will approximate 420,000 units, thanks to the 100,000-a-week clip now being maintained. If a drop of 10 per cent should occur in January, assemblies would total about 380,000, or roughly 150,000 more than in January, 1938. Thus, the industry begins the new year under far more auspicious circumstances than in last December. And it will start with a production roughly comparable to January, 1937, when 399,186 cars and trucks were produced.

November factory sales of cars and trucks were 383,040 units, compared with 376,629 in November a year ago. This figures out as a 1.7 per cent increase.

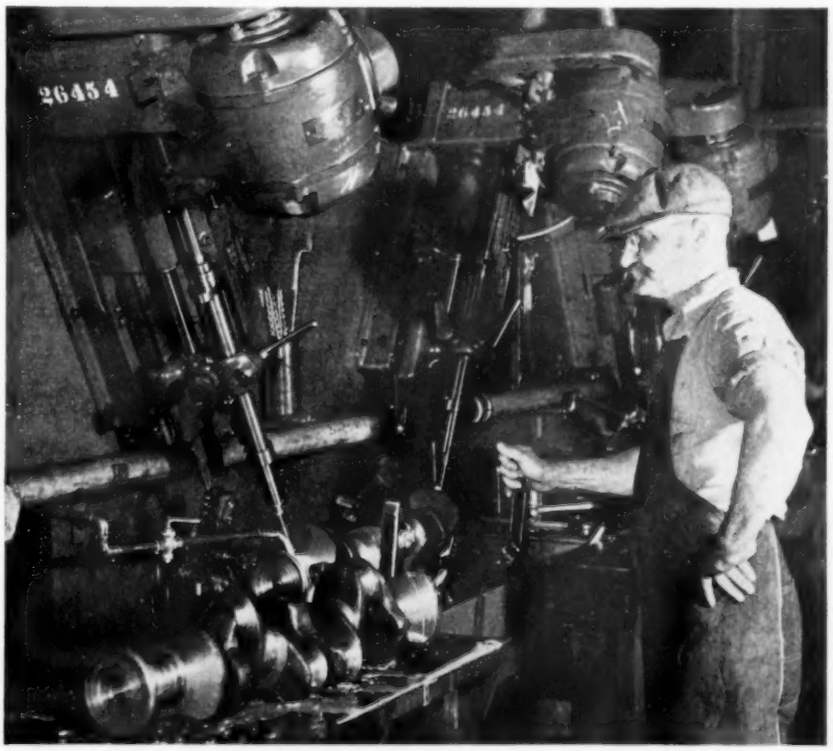
Steel prices for the next quarter, as announced Dec. 3, are substantially the same as now prevailing. Steel "buys" are expected this month from all major car manufacturers, except Chrysler, which loaded up a few weeks back. Purchases are expected on a month-to-month basis, and will be made according to the production curve. Last year the automotive industry bought heavily during the early spring, and the steel industry had a famine for months thereafter, culminating in the orgy of price slashing in October. During one week, a steel company sold as much tonnage as in the entire preceding period back to November, 1937.

Materials must be bought in order to make cars, but the industry continues apathetic toward new equipment. The few inquiries being sent out are solely for fill-in machines or more economical set-ups. Prospects of good machine-tool business through extensive mechanical changes in 1940 cars seem remote. Reliable reports are that few mechanical changes of any consequence will be made in next year's models. No retooling programs are in sight. Cadillac is understood to be working up a new engine, but the time is getting short for consideration of heavy machine tools, and nothing is being done. Packard, which made an announcement of plans for a new job, is doing some work on an equipment layout, but only in a desultory fashion that does not indicate an intention to place the car on the market next fall.

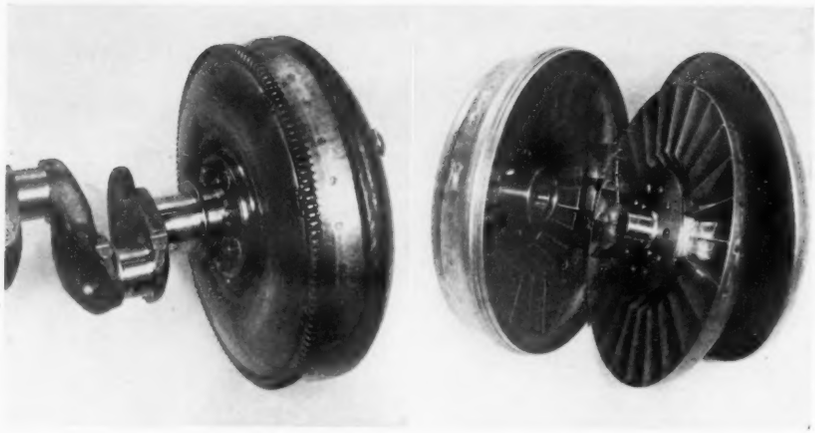
So, it is becoming apparent that most changes in 1940 cars will be in the matter of body styling. Whether much press equipment will be required is highly speculative. Fisher Body and De Soto bought considerable press equipment this year, and Ford did likewise for the new pressed steel shop.

Sporadic strikes continue to flare up. While it is true that they throw thousands of men out of work for a few days and interrupt production, such affairs do not constitute a serious threat to the industry. They are costly, annoying and keep the community on edge, but they are mainly symptoms of growing pains in collective bargaining, and indicative of the factionalism within the union.

Homer Martin has shown a disposition to discipline clear-cut infrac-



Speeds Crankshaft Production—Designed and built by company workmen, this special machine drills two oil holes at a time in Studebaker crankshafts. A bank of three machines, requiring only one operator, drills all the holes in a six-cylinder crankshaft



Chrysler's custom imperial is fitted with a fluid drive as standard equipment. The device in no wise displaces or interferes with the clutch or transmission, but the car can be driven in traffic without shifting or declutching. The drive is made of stamped and forged steel parts. Each fin in the impeller and the runner is spot welded in place

tions of contracts where he has the power to do so. The Plymouth affair is a case in point, and when the union asked that the trouble makers be given a two-weeks lay-off, the business community was heartened.

Still Misunderstanding

A greater measure of peace will not come until misunderstandings are avoided by competent negotiations. Elmer Dowell, who heads union activities in the General Motors plants, wrote the membership that the plant managers are stalling, that they put into effect policies that are unknown to the corporation, and that the plant managers apparently do not understand the corporation's policies and commitments. More likely the truth of the matter is: (1) a lot of ideas and demands advanced by shop committees appear half-baked and get tiresome, (2) these build up resistance when more important demands are made, (3) the shop committees do not prepare their side of the case in a manner likely to win, and when the case is appealed it will not stack up against the manager's presentation, and (4) on some questions a certain amount of "horse trading" must be done, and a show of strength must be made by both sides.

In the case of the Fisher Body strike at Flint, the corporation said that the grievance procedure had not been exhausted, demanded that the men return to work and said it was loathe to substitute hourly rates for piece work in the press shop because slow-downs had been experienced in straight-time departments. Homer Martin finally ordered the men back to work pending further negotiations, but three votes had to be taken before the local agreed to do so. It is a safe bet that production will not be interrupted long at Fisher Body or at any other important unit. The union must reckon with public opinion, lack of WPA funds, and the incoming Governor.

Ford's $34,000,000 expansion program nears completion. The new press shop, which increases capacity for manufacture of body components, is in operation, and most of the equipment is in place. The building is over 1,660 ft. long on the main portion of the L-shaped structure. It is an integral part of a 64-acre plant that converts ore into finished body subassemblies for shipment to branch assembly plants.

The tool and die shop is 1,225 ft. long and 300 ft. wide. It is already employing more than 4,000 men making new dies, tools, jigs, fixtures and gages, as well as general overhaul and building of machinery. Maintenance toolrooms scattered throughout the production divisions will now concentrate on repair work. More than 500 new machines were purchased for the new toolroom.

Both the tool and die shop and the press shop are supported on steel H-beam piling driven as much as 110 ft. to hardpan. Approximately 5,000 tons of steel was used for this purpose alone. Both structures are largely glass. Dining rooms, coat rooms, tiled showers and washrooms, plus air conditioning, have been installed for the comfort of the men.

Fluid Drive

Chrysler has set up a special department in the Dodge plant for building fluid power drives for the Custom Imperial. Production on this car is running about 40 units per month, and it is fitted with the fluid drive as an additional standard feature, which is not a substitute for the usual clutch or transmission.

The fluid drive is an extension of the principle used by Daimler in England, and modified to American practice. It consists of a steel housing with a ring-gear flywheel. Inside there are two vaned wheels. One, called the driver, is attached to the crankshaft. The other, called the runner, drives through the transmission to the rear wheels.

The housing is nearly filled with a light-viscosity oil, which need not be changed during the life of the device. Oil is thrown by the vanes of the driver into the vanes of the runner. The driver always turns a little faster than the runner, but the difference, or slip, is said to be very low, or about 1 per cent.

With the fluid drive a car can be left in high gear, and while idling the car will not move forward until the foot is removed from the brake and accelerator is applied. Declutching is unnecessary when stopping, since the car will not stall. The transmission is used only to secure the required mechanical advantage for such purposes as faster starts, starting on grades, or for backing up.

Advantages of the fluid drive are: the car may be left in high gear and normal traffic followed without shifting gears; torsional vibrations of the engine are damped out; shocks are decreased when accelerating; the car can be driven as slowly as desired in high gear and there will be no bucking.

How quickly the fluid drive will be applied to other Chrysler cars depends on consumer demand and the cost as worked out in the present experimental set-up. It is quite probable that the device will be added to smaller 1940 Chrysler cars, and even to the De Soto.

Over 300,000 Expected at Leipzig Trade Fair

NEW YORK—An attendance of more than 300,000 business men attracted from over 70 countries is expected at the Spring Session of the Leipzig Trade Fair which will be held from March 5 through March 13, 1939.

The oldest and largest industrial exchange in the world, the fair will comprise over 10,000 exhibits of the newest products from 34 of the leading manufacturing countries. Next year's Spring Fair will be the 1981st session of the exhibitions which have been held for more than 700 years.

N.A.M. Adopts More Liberal Attitude, Asks Freedom for Individual Enterprise

Economists predict rise of industrial index for next year as business leaders consider problems of labor, foreign trade and agriculture

NEW YORK—Encouragement of the individual "to think, to work, to save, to invest, to invent, to take risks, to carry on the rivalries of wholesale competition" was urged at the Congress of American Industry conducted by the National Association of Manufacturers at the Waldorf-Astoria Dec. 7–9. America's main problem, said the platform adopted, is "how to apply these time-tested principles and institutions to the conditions and requirements of present-day society."

There were many high spots in the program, the climax of the gathering being the dramatic arrival from England of Anthony Eden, former British Secretary of State for Foreign Affairs, to address the annual banquet. The demand for tickets to hear Mr. Eden far exceeded the capacity of the hotel's accommodations.

The Congress declared in its platform that "continuing and increasing government competition with private enterprise is a major deterrent to the flow of job-creating capital into business." It said that wherever government regulation of industry is necessary, it should be embodied in specific statutes and administered, so far as possible, by established executive departments of the government. If special agencies are necessary, they should be given a minimum of administrative latitude.

No mention was made of the Wagner Act, but a declaration in favor of collective bargaining was adopted. Industry was exhorted to "conduct its business so that it is at all times a desirable citizen of the local community in which it operates." The Congress expressed its support of the national defense program; it sounded a warning, however, that "activity resulting from armament expenditures can only be temporary, creates artificial prosperity, and is thus less desirable from every viewpoint than prosperity arising out of production of goods which improve living standards."

The Congress voiced the opinion that the government should consider lowering tax rates as a means of increasing tax receipts. It suggested creation of a non-partisan committee to study the whole tax problem and make recommendations for complete scientific revision, clarification and simplification of all forms of national, state and local taxes.

Significant in the liberal trend of thought among manufacturers was the statement that "regulation for the public good, of certain aspects of private enterprise, is recognized by all as an essential function of government." On the other hand, the Congress emphasized that "schemes to create purchasing power by artificial redistribution of wealth do not increase production and consequently do not bring about increased employment. Producing more for constantly widening consumption is the only sound form of wealth distribution."

Labor relations held the spotlight the final day of the meeting. Wage-hour administrator Elmer F. Andrews emphasized that "there will be no winking or leniency for violators. However, there will be cooperation, helpfulness and toleration for those who meet us halfway." A question-and-answer discussion was held between Calvert Magruder, counsel for the wage-hour administration, and R. S. Smethurst, associate counsel of the N.A.M. A special resolution was passed seeking equal rights before the law for employers and employees

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Our very existence as an independent nation may be traced to the spirit of individual enterprise shown in colonial times. No combination of privileged interests, no economic dictatorship by government authority produced our past progress. It was achieved only through conditions which encouraged the individual to think, to work, to save, to invest, to invent, to take risks, to carry on the rivalries of wholesome competition. Any program of dictated economy would be a reversal of the American experience and tradition.

America's main problem today is how to apply these time-tested principles and institutions to the conditions and requirements of present-day society.

This task is not the special concern of any one group, but is a national problem. Failure to solve it involves living on the nation's fat and causes a continued decline in living standards. We have already followed this course too long.

—From the platform adopted by the N.A.M.

Charles R. Hook (left), president American Rolling Mill Co., extends best wishes to Howard Coonley, chairman Walworth Co., who succeeds him as president of the N. A. M.

W. T. Holliday, president Standard Oil Co. of Ohio, and W. L. Batt, president SKF Industries, glad that their jobs as vice-chairman and chairman, respectively, of the platform committee are over

B. C. Heacock, president Caterpillar Tractor Co., Tom Girdler, chairman Republic Steel Co., and F. N. Bard, president the Barco Mfg. Co., relax after a session on the problems of business

alike and declaring that the Wagner act does not provide such equal rights.

Charles R. Hook, president, American Rolling Mill Co., offered five points for "Making America Click" in his opening address as president of the N.A.M.:

"1. Let governmental and industrial emphasis be placed on increased production.

"2. The constant encroachment of government competition upon private enterprise must be stopped.

"3. The American people are becoming tax conscious. It is a healthy sign. It means they are becoming more and more interested in the affairs of their own government.

"4. We need in the United States a national labor relations policy based on the American conception of fairness and commonsense.

"5. Give American business a chance to operate under a Square Deal."

This depression is one of those interludes which you won't remember ten or fifteen years from now any more than you now remember that there was a depression in 1924, said David Friday, president National Bureau of Economic Research, in an address on "The Outlook for Business." We are now in moderate recession which is the logical result of stopping an incipient housing boom because of high cost labor and the disturbances caused by strikes in the Great Lakes region particularly. Raised wages and lowered efficiency raised the cost of production so rapidly that profits were depressed and production was discouraged. Many people felt that the revival was false anyhow and were easily discouraged with consequent contraction in buying in late 1937.

Mr. Friday predicted that after a breathing spell for the next two or three months that the Federal Reserve Index of Production for will average 109 or 110 for next year.

Virgil Jordan, president, National Industrial Conference Board, presented a more pessimistic viewpoint although he predicted that the volume of business as a whole will be larger than in 1938 but not as good as in 1937 or 1936. "I do not expect that the industrial production index will equal the high-point of 1937 for any considerable period next year or that it will reach the 1929 peak in the next two years.

"Real recovery from the Great Depression has not yet begun. This situation will continue until a sufficiently large part of the American public and business decides the United States is going to operate permanently under an authoritarian economic organization or under an enterprise organization."

On the basis of surveys Dr. George Gallup reported that efforts to "overhaul" the Wagner Labor Relations Act would meet with "widespread" public support. While people are in favor of collective bargaining, much sentiment exists for amendment of the Act.

"The place for business to really settle both its legislative and its public relations problems is not in Washington or the lobbies of our state legislatures but in the homes of our people," was the opinion expressed by Don Francisco, president, Lord & Thomas.

Business prospects both here and abroad were discussed in a session presided over by J. Howard Pew, president, Sun Oil Co. H. L. Derby, president, American Cyanamid & Chemical Corp. pointed out that as long as workers in other countries are engaged in non-productive armament programs this country can expect to furnish essential materials of life.

Recognition of the transportation problems of the railroads and other carrier is important to business as shippers as well as to the management, according to F. N. Bard, president, Barco Mfg. Co. He asked for passage of emergency transportation legislation at the earliest possible moment without greater restrictions than already exist.

A "Labor Day" closed the meeting which included a talk on "The Fair Labor Standards Act of 1938" by Hon. Elmer F. Andrews, administrator, Wage-Hour Act. Gerard Swope, president, General Electric Co., spoke at the luncheon of that day on "Some Contrasts Between Labor Relations in Great Britain, Sweden and the United States."

Sloan Urges Federal Aid in Modernizing Industry

WASHINGTON—The federal government should encourage industry to scrap its old machinery and install new equipment by reducing taxes of companies which adopt such a policy, testified Alfred P. Sloan, Jr., chairman of General Motors Corp., before the Senate finance subcommittee on Dec. 9. Replacement of old machinery with new would soon be followed by a substantial and general increase in productivity of the entire economic system. "The only way you can raise wages," declared Mr. Sloan, "is by increased productivity per man. It doesn't matter how much you increase wages, prices go up too, unless productivity increases too."

Machinery Orders Down

November machine tool orders were at 112.2, compared with the 118..1 in October, according to the index of the National Machine Tool Builders Association.

General Motors Reveals World Price Trends

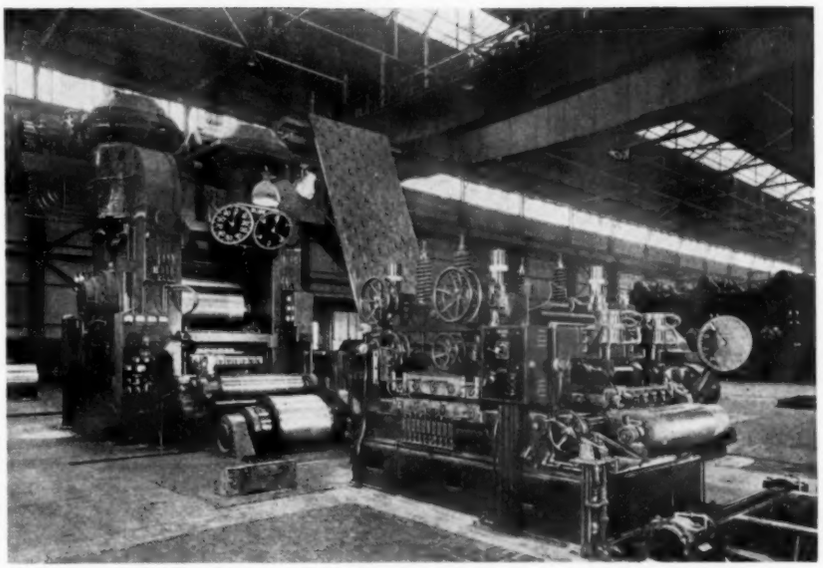
NEW YORK—General Motors Corp., in a joint enterprise with Cornell University, has begun to issue the first weekly world commodity price index based on identical commodities and weights ever made available to the public.

To be known as the General Motors-Cornell World Price Index, the figures will be computed from prices of 40 identical commodities for each country so as to facilitate world comparisons. No data will be considered from countries imposing artificial restrictions on exchange rates. Countries from which prices are being used at present include the United States, Canada, the United Kingdom, Australia, New Zealand, The Netherlands, Belgium, France, Sweden and Finland. It is expected that additional countries will be added to the list from time to time.

The period of 1910–1914 inclusive has been chosen as the base price, since this was a period of comparatively stable economic and currency conditions for all the countries from which prices are being collected.

Cincinnati, Norton to Make Superfinishing Machines

DETROIT—Chrysler Corp. has licensed Cincinnati Milling Machine & Cincinnati Grinders, Inc., and The Norton Co. to manufacture a line of Superfinishing equipment.



Rolls a Variety of Strip—This 54-in. reversing mill installed in the cold reduction department of the new Irvin works of the Carnegie-Illinois Steel Corp. rolls either black or tin plate strip at speeds ranging from 500 to 1100 feet per minute

Management Group Urges Scientific Methods

NEW YORK—Members of the Society for the Advancement of Management repeatedly stressed the importance of the scientific approach in solving present day problems at that organization's annual meeting held Dec. 8–10.

Developments in time and motion study received considerable attention at a session presided over by William R. Mullee, supervisor, Standards Department, American Hard Rubber Co. Also contributing to this discussion were Phil Carroll, Jr., vice-president Dyer Engineers, Inc., and E. R. Summerhayes, Otis Elevator Co.

Outstanding among the round table sessions was a discussion "Education for Management" under the leadership of Hugo Diemer, director of management courses and personnel, LaSalle Extension University. "The Problem of Technical Development" was discussed under the direction of Joseph A. Piacitelli, vice-president Russell A. Allen & Co., while principles of "The Application of Scientific Management to Government Operations," outlined by Perry A. Fellows, assistant chief engineer, Works Progress Administration, aroused considerable interest.

U. S. Government Contracts Awarded to Metal-Working Firms

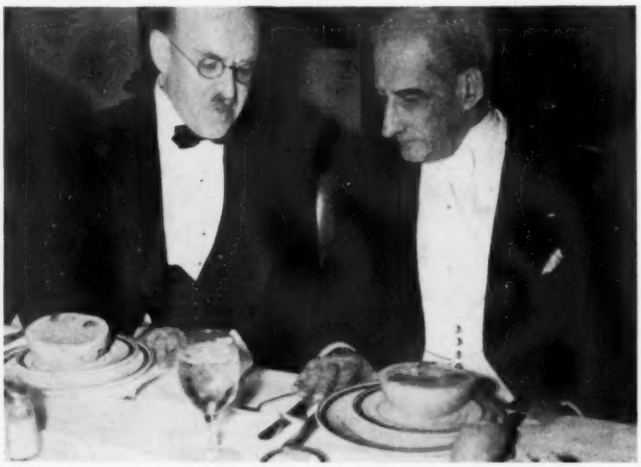
(Awarded from Nov. 14–26 inclusive)

Contractor	Gov't Agency	Commodity	Amount
Elliott Co., Jeannette, Pa	Navy, S&A	Heaters	$84 496
Edge Moor Iron Works, Inc., Edge Moor, Del.	War, Ordnance	Generating units	144,170
Ruth Dredger Mfg. Corp., Los Angeles, Calif.	Agriculture; Interior	Excavating machine	29,970
Westinghouse Electric & Mfg. Co., Knoxville, Tenn	T.V.A	Generator	528,600
American Machine & Metals, Inc., New York, N. Y	Navy, S.&A	Fans	23,164
Jones & Lamson Machine Co., Springfield, Vt.	Navy, S.&A	Thread machines	23,016
Pennsylvania Forge Corp., Philadelphia, Pa.	War, Ordnance	Forgings	10,061
Howard Foundry Co., Chicago, Ill	Navy, S.&A	Protecting cap assemblies	133,510
American Brass Co., Torrington, Conn.	War, Ordnance	Tubing	26,300
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis	Navy, S.&A	Boring, drilling and milling machines	22,338
Frederick Hart & Co., Poughkeepsie, N. Y	Commerce	Key punch parts	19,778
Worthington Pump & Machinery Corp., Harrison, N. J	War, Engineers	Pumping units	185,467
Gleason Works, Rochester, N. Y	Navy, S.&A	Generator	11,326
Aerial Machine & Tool Corp., New York, N. Y	War, Air Corps	Adapter assembly	14,401
Bullard Co., Bridgeport, Conn	Navy, S.&A	Vertical boring mills	39,554
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn	Navy, S.&A	Precision jig boring machine	12,478
Onsrud Machine Works, Inc., Chicago, Ill.	War, ordnance	Woodworking machinery	88,415
Wright Aeronautical Corp., Paterson, N. J.	Navy, S.&A	Engine parts	202,800
Q. C. Engineering Products, Detroit, Mich.	War, Ordnance	Inspection gages	19,170

Machine Tool Exports Show Marked Rise

WASHINGTON—Exports of power-driven metal-working machinery show an increase of 33 per cent over a comparable period of last year, according to figures released recently by the Machinery Division of the Bureau of Foreign and Domestic Commerce. These figures are in direct contrast to those of other industrial machinery exports, which have shown a 10 per cent decline.

The machine tool industry is the only one of the seven major groups tabulated which showed an increase. The greatest decrease was registered by textile sewing and shoe machinery, which dropped 48 per cent.



Ralph E. Flanders, president Jones & Lamson Machine Co. and A.S.M.E. past president, dines with Gerard Swope, president General Electric Co., who delivered the Henry Robinson Towne lecture

Human Side of Management Stressed by Gerard Swope at A.S.M.E. Meeting

Busy week includes many papers of interest to men in the metal-working industry

NEW YORK, N. Y.—"In the enthusiasm for improving materials and methods, the human element was too often overlooked," according to Gerard Swope, president General Electric Co., in delivering the Henry Robinson Towne lecture at the annual meeting of the American Society of Mechanical Engineers in New York, Dec. 5-9. Mr. Swope spoke on Honors Night, Dec. 6, the occasion of the presentation of the A.S.M.E. awards and honors.

Tracing the development of industry from the early attempts of Frederick W. Taylor to put management on a scientific basis, Mr. Swope brought out the human factors involved with the development of the factory system and the progress of mechanization. He showed that in producing more goods for more people at less cost, situations have arisen with which the engineer must cope today. He expressed the belief that policies should be so clarified that any misunderstanding can be settled by means of peaceful conference, rather than by industrial strife. He pointed to the success in Great Britain and Sweden of promoting voluntary negotiations between management and and labor which have greatly reduced the number of strikes in these countries, as contrasted with those in the United States.

"A beginning in social security legislation has been made," said Mr. Swope, "but this work has not reached the finality either in scope or method." He pointed out that management has a great opportunity to stabilize and regularize employment and to assure the worker of a minimum annual wage. "In this way we can come nearer to the ideal that we have endeavored to build up socially by having not only a political democracy, but also an industrial democracy."

Philosophy and Physiology

At the annual dinner held on Dec. 7, Dr. Harvey N. Davis, Stevens Institute of Technology, delivered the presidential address on "An Engineer's Philosophy." In both education and industry, said Dr. Davis, the leaders should strive to build character in the new generation as well as teach facts.

Howard W. Haggard, director of the Laboratory of Applied Physiology of Yale University, gave the Thurston Lecture, using for his subject "Physiology for the Engineer." Toastmaster of the evening was William L. Batt, past president of the A.S.M.E. and president of SKF Industries, Inc.

New A.S.M.E. Officers

PRESIDENT

A. G. Christie
Professor of Mechanical Engineering
Johns Hopkins University

VICE-PRESIDENTS

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Vice-President, Western Blower Co.

James W. Parker
Vice-President, Detroit Edison Co.

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H. H. Snelling
Snelling & Hendricks

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Vice-President
Manufacturers Mutual Fire Insurance Co.

W. H. Winterrowd
Vice-President
Franklin Railway Supply Co.

W. R. Woolrich
Dean, College of Engineering
University of Texas

Among the technical papers of special interest to the metal-working industry was "Modern Hydraulic Units for Machine Tools" by K. R. Herman, Vickers, Inc. Mr. Herman discussed the ways in which many of the problems of machine tool control have been solved by the application of hydraulic mechanisms. Paul S. Jackson, Rockford Machine Tool Co., contributed a paper on a similar subject and showed that the general trend of machine tool design for some years would follow the application of hydraulic units in a wide variety of metal-removing processes.

"Job Evaluation" was the subject of a paper by J. E. Walters, director of personnel, Purdue University. The author illustrated the advantages and disadvantages of various plans in use today. Warner Seely, secretary Warner & Swasey Co., in discussing "The Cost of Apprenticeship" showed that the need of training courses is greater than ever and that the cost to the industry is far less than the value of the benefits derived.

H. E. Golber, research engineer, Miehle Printing Press & Mfg. Co., gave an address on "Rollcurve Gears" by the use of which a follower can be given practically any desired motion in a new machine. A part of the paper

Alexander G. Christie, Johns Hopkins University and new A.S.M.E. president, greets two Canadian neighbors, J. H. Challies, president Engineering Institute of Canada, and J. M. R. Fairbairn, chief engineer Canadian Pacific Railway

H. N. Davis, Stevens Institute of Technology, retiring A.S.M.E. president, makes awards to A. I. Lipetz, American Locomotive Co., Lawford H Fry, Edgewater Steel Co., and Major-General William H. Tschappat, retired, former Chief of Ordnance

was devoted to the "speed-graf" used by the author in applying these gears.

"Hard Surfacing Processes and Materials" was the subject of a paper by M. L. Begeman, University of Texas. The author took up successively such processes as carburizing, nitriding, cyaniding, flame-hardening and metal spraying, giving an idea of the merits of each.

Cutting Fluid Performance

A paper, submitted jointly by Professor O. W. Boston, W. W. Gilbert, and L. V. Colwell, all of the University of Michigan, dealt with "The Effects of Size and Shape of Cut Upon the Performance of Cutting Fluids When Turning S.A.E. 3140 Steel." Based on a series of experiments, an attempt was made to show the influence of various types of cutting fluids as a function of the size of the cut and as a function of the cutting speeds for a given tool life.

E. A. Davis, research engineer, Westinghouse Research Laboratories, reported the result of an investigation as to "The Effects of the Speed of Stretching and the Rate of Loading on the Yielding of Mild Steel." In his experiments, the author used a specially designed machine in which the amount of increase in load per unit time could be held constant.

Lubrication Findings Revealed

Two papers dealing with lubrication were of special interest to those concerned with machine wear. "Thin Oil Films," submitted by Walter Claypoole, research physicist, The Texas Company, told of a method of depositing oil in a highly dispersed fog consisting largely of positively charged particles.

L. M. Tichvinsky, research engineer, Westinghouse Electric & Mfg. Co., presented his findings on boundary or semi-fluid friction which takes place in the bearings of practically all rotating machines when they are started or brought to a standstill.

Safety in plant layout was the topic of F. J. Van Toppelen, industrial engineer, Remington Arms Co. Without attempting to give a detailed set of safety rules and regulations, the author covered various factors affecting human and economic conditions.

Locomotive Developments

"The Question of Counterbalancing Reciprocating Weights in Steam Locomotives" was the topic of a paper by A. I. Lipetz, chief consulting engineer, American Locomotive Co. Included in the paper was an example of a correct calculation of the cross counterbalancing of all weights, revolving and reciprocating. Trends in design of electric locomotives during the last 30 years were traced by B. F. Cain, Transportation Engineering Department, General Electric Co. The author showed that the use of welding and high strength steels had resulted in good riding qualities and strong construction. Another paper dealing with railroads was submitted by R. Eksergian, consulting engineer, Edward G. Budd Mfg. Co. Discussing "Motive Power Characteristics and Light Weight Equipment," the author gave a comparison of steam, diesel-electric and straight electric locomotives.

An interesting analysis of the failure of a war model 240-mm. howitzer was given by Colonel G. F. Jenks, Ordnance Department, U. S. Army. This paper included a description of the method of reading rupture flow lines on the surface of fragments of the structure.

"Methods of Rotor-Unbalance Determination" were discussed by J. G. Baker, mechanical engineer, Westinghouse Research Laboratories, Hamilton Standard Propeller Division of the United Aircraft Corporation and Baker Mfg. Company.

In addition to the technical papers, members and guests of the A.S.M.E. were occupied with plant visits, sightseeing trips, luncheons and committee meetings. Plant visits included the Essex Generating Station of the Public Service Electric & Gas Company of New Jersey, the Waterside Station of the Consolidated Edison Co. of New York, and the Williamsburg Station, Williamsburg Power Plant Corporation. Among the sightseeing trips was one to the New York World's Fair.

Among the spectators were Carl L. Bausch, Bausch & Lomb Co. and W. Lyle Dudley, vice-president of the Westinghouse Blower Co. and a new A.S.M.E. vice-president

WATCHING WASHINGTON

Monopoly investigation begins with inquiries into economics of industry . . . Automotive patent pooling practices arouse little concern . . . Opinion divided over "defense of western hemisphere" issue . . . Pump priming or not, armament production will be upped

McGRAW-HILL WASHINGTON BUREAU
Paul Wooton, Chief

WASHINGTON—When Congress first authorized a committee study of "monopoly and the concentration of economic power" with a view to determining "the causes and effects of such concentration," industry was inclined to look upon the action as another attempt of the New Deal to make it walk the plank. But that was back a few months ago before a more conservative trend in public opinion was so noticeable. When the inquiry actually got under way in Washington last week by the Temporary National Economic Committee, many of the fears had been swept away. Initial hearings by the committee tended further to dispel any misapprehensions.

Instead of an inquiry directed toward pillorying business, the first sessions were steeped in economics. Isador Lubin, whose reputation with industry is high, presented a study of the national income since 1929. He argued that if the economic status of the 5,000,000 families who had an income of $1,250 or less in 1935–36 could be raised, "surplus capacity would disappear in the vast majority of our industry." Mr. Thorpe of the Commerce Department undertook to give a blueprint of the American economic machine, complicated as it is. Though concentrations of economic power are found, actual monopoly is rare, he said.

"Why . . . ?"

Following these two gentlemen, Leon Henderson, executive secretary of the committee, raised the question, "Why have we not had full employment and full utilization of our magnificent resources?" It is the answer to that question which the committee would like to get. Obviously, the committee has cut out for itself quite a task.

So industry sighed with relief when the hearing got under way with a commendable absence of an attitude of business hositility. Only the barbed questions and comments of Assistant Attorney-General Thurman Arnold, bugaboo to most business men, reminded one of other New Deal hearings of a harsher character.

No Automotive Dynamite

Nothing sensational was churned up by the committee in its questioning of automotive leaders. In fact, motor car makers indicated that they wouldn't get very excited whether the patent system kept or not, though they had no recommendations for changing its present status. In the testimony of all the men—Edsel Ford, W. S. Knudsen and "Boss" Kettering—was the thought that the industry has passed the stage where patents are of great importance unless some revolutionary and unforeseen development occurred. Patents are taken out mostly to protect companies from possible infringement suits in the event that outside inventors patent similar devices. Ford, since it upset the Selden patent in 1911, has granted free licenses to all who want to use its patents. It, in turn, pays no royalties on licenses granted to it.

Swap Patents

Members of the Automobile Manufacturers Association have had a free exchange of licenses with some reservations since 1915. Back in 1935 the agreement was extended only with respect to patents issued up to 1930, but this doesn't mean much anymore because the patents have little value. Regardless of what happens to the patent situation, the big companies will continue to push research and will rely on manufacturing efficiency to maintain their competitive positions.

To Defend the Hemisphere?

All sorts of stories and opinions about national defense are kicking around Washington. The administration seems firmly convinced that Hitler won at Munich on the point that he had some 9,000 airplanes available. Investigation appears to have proved the accuracy of that supposition. Around the airplane star the administration wants to swell the chorus of battle fleets, mechanized armies, machine shop and aircraft mechanics, and legions of pilots to fly the planes. We must defend the western hemisphere. On the other hand, there is one group which says that the "defense of the western hemisphere" is pretty extreme. Maybe the countries south of the United States don't want to be defended. The commercial contest over Latin America can turn to war only if foreign countries get a sufficient foothold there. That can be prevented by good salesmanship on the part of the United States, not with guns.

Another group is saying that the President hopes to win continued approval by priming guns instead of pumps. However, the President appears to have overwhelming support of the country in his handling of foreign affairs and he will get from Congress a large portion of the arms money which he seeks, but not until late in the Congressional session.

TAX REVISIONS—MAYBE

A flat corporation income tax of 18 per cent instead of the present sliding scale from 16½–19 per cent is the best bet as to tax changes to be made by the incoming Congress. Congress is eager to wipe out the last vestige of the punitive tax on undistributed earnings, despite a strong White House desire to retain the present sliding scale based on the amount of earnings paid out in dividends. Motive for the change is the conviction that the present sliding scale favors big corporations, which, paying out most of their earnings, get the lower rate, while the little fellows, afraid to risk a bad year, put a larger portion of their earnings in surplus and thus must pay the 19 per cent rate. Treasury experts will not risk White House wrath by endorsing the change, but they would like it, figuring the straight 18 per cent would produce more revenue.

President Roosevelt is more interested in "soaking" capital gains than in retaining his pet undistributed-profit-tax theory, and will fight to have more drastic provisions for penalizing speculators, but is likely to find Congress arrayed against him. There will not be much speed about the tax legislation. Contrary to custom, no sub-committees were set up to work out preliminary drafts of the tax bill by either the House or Senate, so the work will start from scratch in January.

PERSONALS

W. S. EDSALL

W. J. O'NEIL

G. A. BURNHAM

W. J. O'NEIL, vice-president Dodge Bros. Corp., has been appointed president and general manager of that division of Chrysler Corp., according to a recent announcement by K. T. KELLER, Chrysler president. Mr. Keller has been president of Dodge since its acquisition by Chrysler in 1928.

After finishing business college in 1900, Mr. O'Neil went to work as secretary to the president of the Nordburg Mfg. Co. of Milwaukee, and a year later began an apprentice course there. Completing this course at Allis-Chalmers, he spent four years as a machinist and toolmaker for the St. Paul Railroad and Filer & Stowell Co., Milwaukee; Western Electric Co. and Allis-Chalmers Co., Chicago; Wagner Electric Co., St. Louis; and E. W. Bliss, Brooklyn.

Mr. O'Neil first became associated with the automobile industry in 1907 as night superintendent of the Milwaukee Motor Co. In 1911 he joined the Packard Motor Co., leaving in 1914 to head the gas engine department of Fairbanks-Morse. He later served as works manager for the A. O. Smith Co. until 1921, when he joined the Maxwell Motor Co. In 1928, when the Dodge properties were acquired by Chrysler, Mr. O'Neil was made plant manager of the Dodge division. In 1930 he was appointed vice-president in charge of manufacturing, and was named vice-president and general manager in 1935.

W. S. EDSALL, sales manager of the Condit works of the Allis-Chalmers Mfg. Co., Boston, has been appointed assistant manager of the company's electrical department in charge of the switchgear sales and engineering division of the Condit Works. He succeeds GEORGE A. BURNHAM, who has resigned to devote more time to travel.

Mr. Edsall entered the employ of the Condit Mfg. Co. of Boston in 1920, becoming sales manager in 1922. In 1928 he was appointed general sales manager of the American Brown-Boveri Co. and also a director of Condit Mfg. Corp. When Allis-Chalmers purchased these companies in 1931, Mr. Edsall continued as manager of sales for the Condit works and later for the switchgear division.

W. O. BATES, JR., recently appointed head of the patent department of the Caterpillar Tractor Co., has been named as a vice-president of that organization.

W. A. BECHILL, of the DeSoto Div., Chrysler Corp., was elected general chairman of the executive committee, Automotive and Machine Shop Section of the National Safety Council, at that organization's recent Silver Jubilee Congress in Chicago. Other officers elected include: J. C. BOWER, Westinghouse Electric & Mfg. Co., vice-chairman; L. G. SEATON, General Motors Corp., vice-chairman; L. B. LOOMIS, Ternstedt Mfg. Div., General Motors Corp., secretary; R. A. SHAW, Murray Corp. of America, engineering committee chairman.

GUY C. BEISHLINE, formerly assistant to the vice-president in charge of operations, American Car & Foundry Co., has been named district manager in charge of the company's Berwick, Pa. plant. He succeeds WILLIAM S. JOHNSON, who has retired after 53 years of service.

HOWARD V. CLARK, formerly general manager of the order division, Carnegie-Illinois Steel Corp., has been named manager of sales of the sheet division of the organization's general sales department. He will succeed AVERY C. ADAMS, who resigned recently.

W. HOMER HARTZ has been nominated as 1939 president of the Illinois Manufacturers Association, according to a recent announcement. Mr. Hartz, who is president of the Morden Frog & Crossing Works and a past president of the National Railway Appliance Association, has been a director of the association for several years. Other nominees include: J. E. OTIS, JR., Stewart-Warner Corp., first vice-president; ROBERT M. GAYLORD, Ingersoll Milling Machine Co., second vice-president; STERLING MORTON, Morton Salt Co., treasurer.

D. J. HAWTHORNE, works manager of the Westclox division of General Time Instruments Corp., has been made assistant general manager of the company's Peru, Ill., plant.

RUSSELL O. HUNT has been appointed assistant rolling mill superintendent in charge of steel preparation, Duquesne works of the Carnegie-Illinois Steel Corp. EDWARD J. CHELIUS has been named assistant to the superintendent of the open hearth department in charge of electric furnace steel production, while DENNIS A. CROWLEY has been made assistant chief metallurgist in charge of inspection and testing.

W. K. HYSLOP, formerly general European manager of the Massey-Harris Co., has been appointed general manager of that organization's Batavia, N. Y., and Racine, Wis., plants.

ROBERT A. JONES, engineer at the Buffalo office of the General Electric Co., has been appointed assistant engineer for the company in the New York district, according to a recent announcement by H. H. BARNES, JR., commercial vice-president. Mr. Jones' place will be assumed by W. C. PLUMER of the company's Newark office, who in turn will be succeeded by L. F. STONE.

JAMES H. MCGRAW, JR., president McGRAW-HILL Publishing Co., has been elected to the board of directors of the American Arbitration Association, according to a recent announcement by LUCIUS R. EASTMAN, chairman of the board of the association.

W. V. O'BRIEN has been appointed assistant to the manager of the lighting and cable division of the central station department, General Electric Co., according to a recent announcement by F. H. WINKLEY, division manager.

DONALD A. ROBISON, formerly treasurer Caterpillar Tractor Co., has been appointed general sales manager. W. J. MCBRIAN, domestic credit manager, has been promoted to head the treasury department.

W. W. SEBALD, vice-president and assistant general manager of the American Rolling Mill Co., has been elected a director, according to a recent announcement by CHARLES R. HOOK, president. Mr. Sebald fills the vacancy caused by the death of J. H. FRANTZ.

J. E. SIMMONS, previously manager of Chevrolet's New York zone, has been named assistant regional manager for the Atlantic Coast, it was announced recently by W. E. HOLLER, general sales manager.

GEORGE H. SPENCER has joined Bantam Bearings Corp., to take charge of the New England district.

W. A. TIPTON, packing sales manager of the mechanical goods division of United States Rubber Products, Inc., was appointed a director of the Rubber Division of the Mechanical Packing Association at a recent meeting of the association's board of directors.

JOHN W. VOTYPKA, for the past twelve years chief engineer of the LeBaron Div., Briggs Mfg. Co., Detroit, has been appointed chief engineer of the Fruehauf Trailer Co. WILLIAM R. MYERS, formerly manager of a Detroit Briggs plant, has been appointed plant manager of Fruehauf.

R. H. ZILMAN has been appointed chief engineer of the Thew Shovel Co., Lorain, Ohio. Mr. Zeilman will be in charge of the company's enlarged engineering department at the Lorain factory. A. J. GILLESPIE has been named assistant chief engineer.

BUSINESS ITEMS

The Allen-Bradley Co., Milwaukee, Wis., has appointed the Industrial Machinery Co., Great Falls, Mont., to handle the Allen-Bradley line of motor control equipment in the Montana and northern Idaho territories. PAUL R. URICH, Erie, Pa., has been named representative for the Erie territory.

The American Bridge Co. has been awarded a contract by the New York City Board of Estimate for approximately 17,000 tons of structural steel for a new bridge which will lead to the New York World's Fair grounds.

The Bethlehem Steel Corp., as a further step in its program of consolidation, has merged the Bethlehem Shipbuilding Corp., a subsidiary organization, into the Bethlehem Steel Co. A new division of Bethlehem Steel, under the direction of S. W. WATEMAN, vice-president, will handle business previously conducted by Bethlehem Shipbuilding.

The Charles Bond Co., Philadelphia, has announced the appointment of the F. Raniville Co., Grand Rapids, Mich., as distributor of Bond stock gears and speed reducers.

The Central Railroad of New Jersey and the Reading Co. have ordered fifteen new 600-hp. diesel switching locomotives, according to an announcement by EDWARD W. SCHEER, president of both organizations. Electro-Motive Corp. has contracted to build nine, American Locomotive four, and Baldwin Locomotive Works and Fairbanks-Morse one each. Costing about $65,000 each, ten of the units will be used on the Central of Jersey and five on the Reading.

The Federal Electric Products Corp., electric switch and panelboard manufacturer, has acquired a 23,000-sq.ft. plant in Newark, N. J. where another structure will be erected to provide an additional 20,000 sq.ft.

The Ferracute Machine Co., Bridgeton, N. J., has been licensed to manufacture a line of steel press brakes formerly made by the Rafter Machine Co., Belleville, N. J. The products will be distributed through the Bryant Machinery & Engineering Co., Chicago, Ill.

The Keystone Steel & Wire Co., Peoria, Ill., wire products manufacturer, is planning to rebuild part of its plant which was recently destroyed by fire.

The Kuhlman Electric Co. has purchased the Detroit Electric Furnace Co. and will hereafter operate it as the Detroit Electric Furnace Div., Kuhlman Electric Co., Bay City, Mich., according to a joint announcement by both organizations. The same sales, service and production personnel which have been with the Detroit company will continue in their duties, under the direction of A. E. RHOADS. The company's offices, machine shop, experimental equipment and parts stock will be transferred to Bay City immediately.

The Lake Erie Engineering Corp., Buffalo hydraulic press manufacturer, is constructing an addition to its facilities which will triple the floor space available for its engineering department.

The Lenert-Wauseon Aircraft Co., builder of training planes, will move its factory to Toledo, Ohio, according to a recent announcement.

The McKenna Metals Co., Latrobe, Pa., has licensed George H. Alexander Machinery, Ltd., Birmingham, England, to manufacture tools of "Kennametal," a tungsten titanium carbide compound.

The Monarch Machine Tool Co., Sidney, Ohio, is expanding its office facilities by the construction of a new two-story building which will replace the present offices and add about 35,000 sq. ft. of plant space.

The Prentice Mfg. Co., New Britain, Conn., manufacturer of slide fasteners, plans to open a new factory in California, according to a recent statement by GEORGE E. PRENTICE, president. Mr. Prentice stated that the new plant would probably be located in Los Angeles, where operations are expected to be under way early in 1939.

A. G. Spaulding & Bros. have developed a method of high-speed photography, with exposures down to 1/100,000 second, for the purpose of analyzing motion to study what happens in high-speed movements.

By the new process, single or multiple exposures can be made, the latter showing the moving part in as many positions of its movement as desired. This is done by accurately controlling intense flashes of light that insure perfect images on the sensitive plate. Although developed for application to golf clubs and other sporting apparatus, the new method has many applications in industry.

The Sun Shipbuilding & Dry Dock Company's low bid of $2,729,000 each for the construction of four diesel Type C-3 cargo vessels has been accepted by the United States Maritime Commission, it was announced recently. This brings to a total of fourteen the number of diesel cargo ships now under construction.

MEETINGS

AMERICAN ENGINEERING COUNCIL. Nineteenth annual assembly, Jan. 12–13, Mayflower Hotel, Washington, D. C. Executive secretary, F. M. FEIKER, 744 Jackson Place, N. W., Washington, D. C.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Winter convention, Jan. 23–27, New York, N. Y. H. H. HENLINE, secretary, 33 W. 39th St., New York, N. Y.

AMERICAN RAILWAY ENGINEERING ASSOCIATION. Annual meeting, Palmer House, Chicago, Ill., March 14–16. W. S. LACHER, secretary, 59 E. Van Buren St., Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting, Jan. 18–21, New York, N. Y. Society secretary, GEORGE T. SEABURY, 33 W. 39th St., New York, N. Y.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. Annual meeting, Jan. 23–26, William Penn Hotel, Pittsburgh, Pa. A. HUTCHINSON, secretary, 51 Madison Ave., New York, N. Y.

SOCIETY OF AUTOMOTIVE ENGINEERS. Annual meeting, Book-Cadillac Hotel, Detroit, Mich., Jan. 9–13.

OBITUARIES

ERNEST J. BEYER, for 25 years factory and production manager of the Zenith Carburetor Div., Bendix Aviation Corp., Detroit, died Dec. 7. He was 63 years of age.

ERNEST D. CROCKETT, for the past 30 years representative of Henry Prentiss & Co., died in Springfield, Mass., Nov. 24. He was 56 years of age.

PERCY C. DAY, vice-president and chief engineer of the Falk Corp., Milwaukee, died Dec. 7 at his home in Elm Grove, Wis. He was 63 years old.

RAYMOND S. GOUGH, 59, for the past 40 years associated with subsidiaries of the U. S. Steel Corp., died suddenly at his home in Pittsburgh Nov. 27.

DAVID B. HANNA, 80, prominent Canadian industrialist and first president of the Canadian National Railways, died in Toronto, Dec. 1, following a heart attack.

ARTHUR S. HUGHES, 60, president and founder of the Hughes-Keenan Structural Iron Co., Mansfield, Ohio, died of a heart attack Nov. 27.

J. A. MOSAL, 71, president Mississippi Foundry & Machine Co., died at his home in Jackson, Miss., Nov. 24.

ARTHUR W. NORTON, former vice-president of the Continental Can Co., died Nov. 30 at his home in Baltimore. He was 60 years of age.

JOHN M. PATON, 69, assistant to the president of the American Steel & Wire Co., Cleveland, Ohio, died Nov. 29 in that city. Mr. Paton had seen 49 years of service with the organization.

CHARLES F. SMITH, 77, chairman of the board of directors of Landers, Frary & Clark, New Britain electrical appliance manufacturer, died Dec. 4 following a short illness. Mr. Smith was also a director of the American Hardware Corp., the Blake & Johnson Mfg. Co., and the Goss & DeLeeuw Machine Co.

JOHN E. STETSON, 60, treasurer and general manager of the Bryant Chucking Grinder Co., Springfield, Vt., died Dec. 6 at his home in that city following an illness of several weeks.

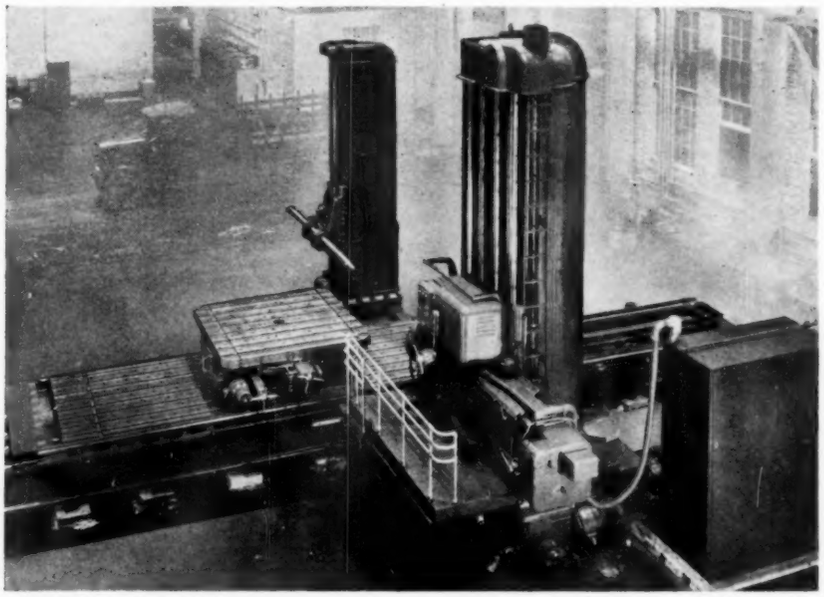
Mr. Stetson joined the company in 1910 as secretary. He became treasurer in 1913, and in 1931 assumed the additional duties of general manager.

HARLAN E. SNODGRASS, 65, past president of the Newark Tube & Metal Works, Newark, N. J., died Dec. 6 at his home in Summit, N. J.

EDGAR L. VALANCE, 56, assistant general manager of the Houde Engineering Corp., died Nov. 24 in Buffalo, N. Y.

SHOP EQUIPMENT NEWS

Ingersoll 7-In. Open-Side Boring Machine



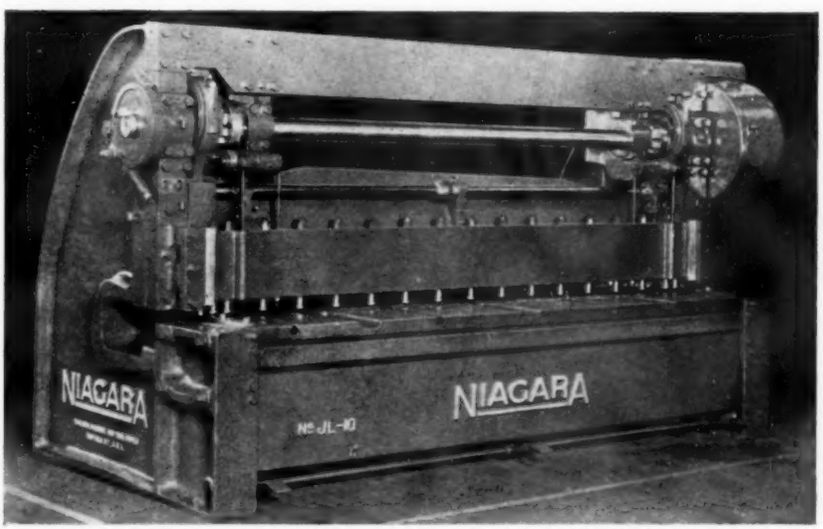
This 7-in. bar, open-side milling and boring machine was designed and built by the Ingersoll Milling Machine Co., Rockford, Ill. for machining large turbine and gear reduction cases. It is equipped with a planer-type table and incorporates means for quickly bringing the outboard support and the spindle into accurate alignment when changing the setting from one whole to another.

The motor driven saddle carries an auxiliary slide which, in turn, carries the 7-in. diameter boring spindle. Either the slide or the bar can be fed or traversed independently. This compound slide is said to be of particular advantage when milling and stub boring away from the face of the housing, as the front bearing support for the bar may be brought out close to the work.

The operator may control this machine either from the control platform, through a stationary panel mounted on the saddle, or from a portable pushbutton station which can be carried to any position on the table. Feeds or speeds may be varied without stopping the cut, permitting the machine to work at full capacity as the depth of stock varies.

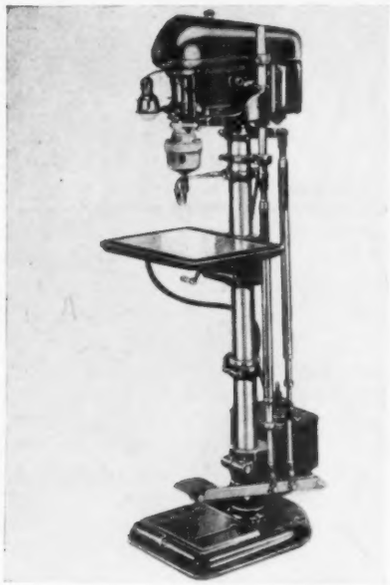
Niagara Series JL Power Squaring Shears

Series JL power squaring shears offered by Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., are available in several standard cutting lengths and have capacity for $\frac{1}{4}$-in. thick sheet steel. Incorporated in the design of these shears are a completely inclosed drive with gears mounted on anti-friction bearings and running in oil, a 14 point sleeve clutch with built-in single stroke mechanism, and a ball-bearing type self-measuring parallel back gage. These shears are accessible at the rear for convenient setting of the back gage and easy removal of sheared pieces.



Procunier "Universal" Tapping Machines

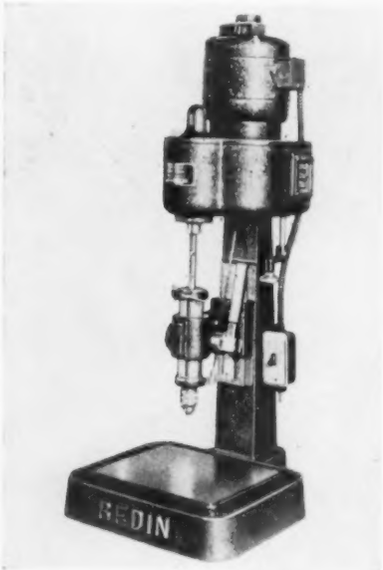
By using two interchangeable high-speed precision tapping heads, the "Universal" tapping machine announced by Procunier Safety Chuck Co., 18 S. Clinton St., Chicago, Ill., will handle tap sizes ranging from No. 2 to $\frac{5}{16}$ in. in steel, $\frac{3}{8}$ in. in cast iron, and $\frac{1}{2}$ in. in brass. The inclosed drive provides four speeds of 390, 745, 1,280 and 2,050 r.p.m. The foot-operated control mechanism permits the operator complete use of both hands for handling parts. The Type AA machine shown is equipped with an automatic piston-type lubricating device to supply the correct amount of cutting compound to the tap at the correct time. It has an adjustment for quantity of lubricant delivered as well as for the timing of the flow. The Model AB unit is furnished without this lubricating device. Specifications: size of table surface, 11 x 16 in.,



spindle travel, 3½ in.; distance from column to center of tap, 7 in.; distance from point of tap to table, 0-25 in.; floor space required, 20 x 25 in.; overall height, 66 in.; net weight 300 lb.

"Redin" Model O Bench-Type Drill

A "rolling wedge" four-speed transmission is incorporated in the drive of the "Redin" No. 0 bench-type sensitive drill press made by the Crescent Mfg. Co., 1104 Tenth St., Rockford, Ill. This drive is claimed to be vibrationless and to adjust its pressure automatically according to the resistance of the work being done. Speed changes may be made while the motor is idle or running.

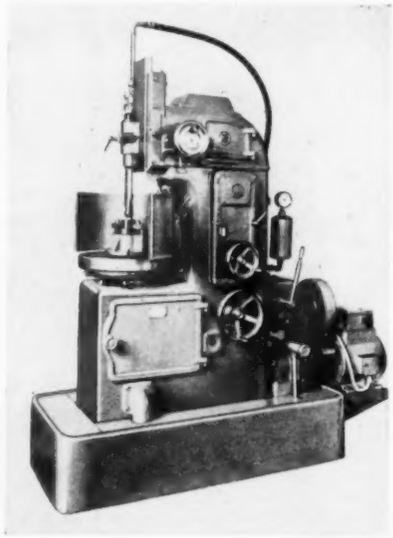


Specifications: drilling capacity, $\frac{5}{16}$ in.; spindle travel, $3\frac{3}{8}$ in.; distance from spindle to column, $6\frac{1}{2}$ in.; distance from table to chuck, 2–$8\frac{1}{4}$ in.; size of table, 10 x 12 in.; over-all size of machine, 16 in. wide, $19\frac{1}{2}$ in. deep and 38 in. high; traverse of sliding head, $5\frac{1}{4}$ in.; spindle speeds, 900, 1,800, 3,300 and 5,000 r.p.m.; size of motor, ½ hp.

"Saurer" Internal Spline Grinder

A small turbine rotor mounted alongside the grinding wheel on the spindle shaft of the Saurer internal spline grinder is driven by soda water pumped under high pressure and directed on the turbine blades. This soda water is carried through a flexible hose line to the top of the hollow spindle, through which it travels to the nozzle above the turbine rotor. Speed of the grinding wheel is regulated by a valve in the pressure line. This machine, manufactured by the Saurer Co. in Switzerland, is marketed in the United States by W. A. Schuyler, 250 W. 57th St., New York, N. Y.

The machine can grind from 4 to 24 splines of square or involute profile in bores ranging from ¾ to $4\frac{11}{16}$ in. in diameter and up to 7 in. long. A cupped wheel is used for square splines and a profile wheel is used for involute splines. A wheel dressing device is provided for either type of wheel.



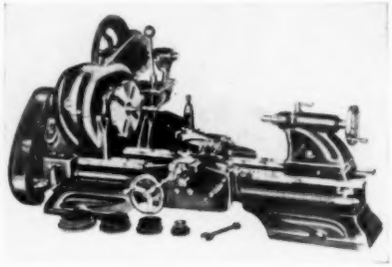
Internal splines can be ground in bores 7-in. long with this Saurer machine

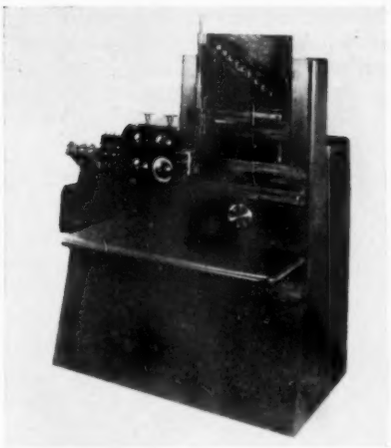
The grinding apparatus is mounted in a vertical slide which reciprocates in the vertical ways on the front of the column head. On the down stroke of this slide the wheel grinds one flank of the spline and, before it starts the up-stroke, it moves diametrically across the bore to grind the flank lying in the same plane on the opposite spline. Thus, the work cycle is completed for one spline with each reciprocation of the wheel. A cross slide on the column head provides for feeding the wheel against the spline flank. Feed can be regulated by a graduated feeding wheel which is either hand operated or driven from the table by a cam-operated push rod.

A small turbine rotor is direct-connected to the grinding wheel

Atlas Series F 10-In. Bench Lathe

A power cross feed mechanism is included as standard equipment on the Series F 10-in. screw-cutting bench lathe announced by Atlas Press Co., Kalamazoo, Mich. This lathe has 18-in. capacity between centers with a 36-in. bed. It also is available in 42, 48 and 54 in. bed lengths. Over-all height is 19 in. and over-all depth is 26 in. The carriage is of two-piece construction and felt wipers are used to keep the bed ways free from dirt and chips.



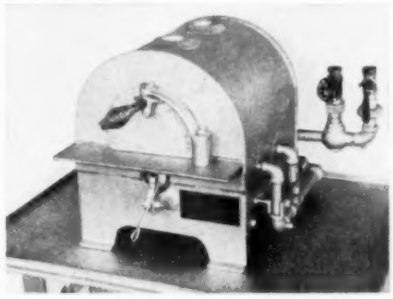


"Economy" Model F-26 Automatic Wire Former

Flat or round wire is taken from the coil and rapidly straightened, cut off, and formed to desired shapes in the "Multeplex" Model F-26 heavy-duty wire forming machine, developed by Economy Tool & Machine Co., 10 W. Delano St., Muskegon Heights, Mich. An automatic ejector removes the wire from the die at each stroke of the machine. Flat wire up to $\frac{1}{8}$ x $\frac{3}{4}$ in. can be straightened, cut off and formed, depending upon the number of bends. In round wire, the machine has capacity for straightening and cutting off $\frac{3}{8}$ in. wire and for straightening, cutting off and forming by $\frac{5}{16}$ in. wire. All of these can be handled in lengths up to 26 in. at the rate of up to 120 pieces per minute.

Improved No. 2½ Muffle Furnace

Suitable for small shops where a muffle furnace is preferred, the improved No. 2½ muffle furnace offered by the American Gas Furnace Co., Elizabeth, N. J., has a Sillimanite muffle measuring 4¼ in. wide, 2¾ in. high and 7½ in. deep. If desired, it can be supplied with a hearth slab 4½ in. wide by 7½ in. long in place of the muffle. Hearth entrance measures 4 in. wide and 2⅝ in. high. It is suitable for temperatures up to 2,000 F. Required bench space is 20 x 19 in.

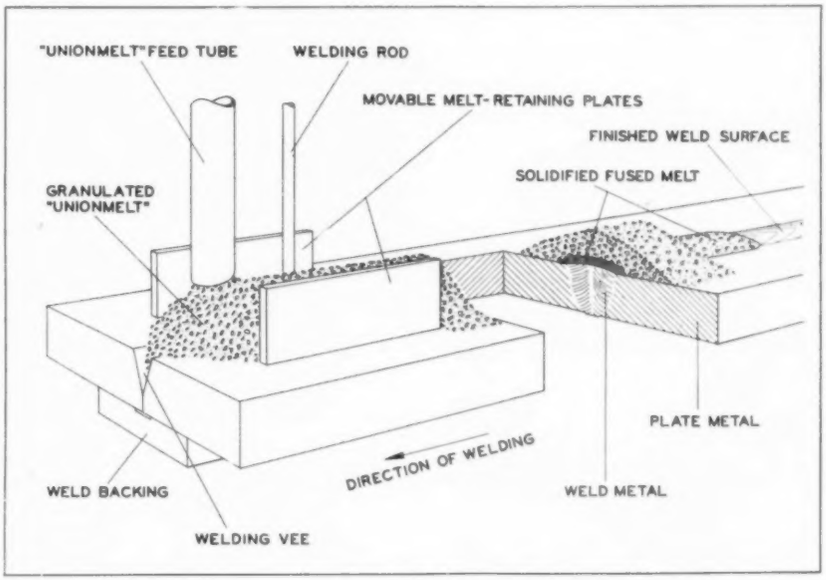


Linde "Unionmelt" Welding Process

The "Unionmelt" electric welding process developed by The Linde Air Products Co., 30 E. 42nd St., New York, N. Y., keeps the end of the welding electrode constantly covered by a highly resistant, conductive medium, supplied as a special granulated material. This material automatically is laid down along the seam a few inches in front of the head, and the entire welding action takes place beneath it without a visible arc and without sparks, spatter, smoke or flash. Within the layer of "Unionmelt" granulated material an intense, concentrated heat is generated by the electric current. Molten metal from the electrode is mixed with the melted base metal to form the weld. When a weld is being made a subsurface layer of the "Unionmelt" melts and floats as a liquid blanket over the molten weld metal.

The "Unionmelt" welding composition makes possible the use of higher current densities and permits the rapid generation of intense heat. It is a good heat insulator and concentrates the welding heat in a relatively small zone. Also, it acts as a cleanser for the weld metal, washing the metal which melts from the rod and absorbing impurities from the fused base metal. It excludes the atmosphere and other gases from the weld metal, consequently the weld metal is clean and dense.

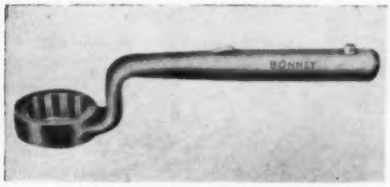
In operation, this welding process is fully automatic, but it requires starting with a special fuse of some good conductor, such as a wad of steel wool, since the granulated material is not a conductor of electricity. Bare welding rod is fed continuously from a special rod reel into the welding zone by the "Unionmelt" welding head. Since only part of the "Unionmelt" material is fused during the welding, the unfused material is picked up, usually by a suction cleaner and returned to a hopper for reuse. The fused melt solidifies behind the welding zone and, on cooling, contracts and breaks away from the weld. Welding voltage, current, speed and rod feed all are automatically regulated by electric controls. The process will make butt welds, fillet welds and plug welds of desired practical penetration and contour in commercially used thicknesses of material. Quality butt welds can be made at 10-12 in. per min. in 1-in. steel plate and at 5-6 in. per min. in a 2-in. plate.



"Bonney" Heavy-Duty Box Wrenches

A line of heavy-duty box wrenches with interchangeable tubular handles has been announced by the Bonney Forge & Tool Works, Allentown, Pa. Made in both double-offset as shown, and 15 deg. angle types, these wrenches are drop forged from chrome-alloy steel. Each type is made in seven sizes with double hexagon openings ranging from 1⅝ in. to 2¼ in. One size of interchangeable tubular handle is made of seamless

steel tubing to fit all of the 14 wrenches in this line. It is 30 in. long and provides the extra leverage necessary when turning large nuts. Holes are provided in each end of the handle to assure positive locking of the spring-ball plunger in the end of the wrench shank.



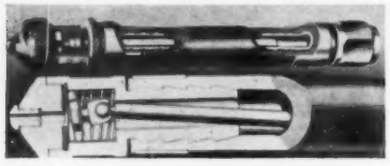
"Shield-Arc" Welders

A line of "Shield-Arc" welders offered by the Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio, has both job selector and current control calibrated and equipped with dials which indicate the type of work and the number of amperes for each set-

ting. Both the voltage control and current control are continuous in operation. Controls can be advanced or retarded in increments as fine as desired. These welders are available in a.c. and d.c. motor driven types, belted or coupled, and in gasoline engine and diesel driven types, in all standard ratings.

Airway Offers "Air-O-Chek" Valve

An "Air-O-Chek" valve unit that screws onto the end of the air hose has been announced by the Air-way Pump & Equipment Co., 625 W. Jackson Blvd., Chicago, Ill. This air valve employs the "Air-O-Chek" ball and socket joint with inclosed actuating lever, a slight pressure between the thumb and finger to flex the hose gives an instant flow of air.



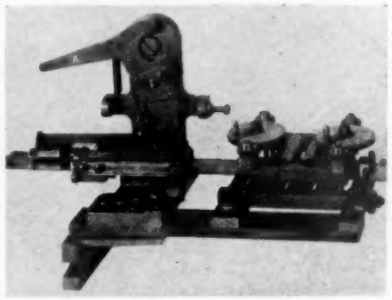
Fostoria Type FA Fluorescent Localities

Two 18-in. fifteen-watt fluorescent lamps are used in each of the fluorescent type canopy localities offered by The Fostoria Pressed Steel Corp.,

Fostoria, Ohio. Five different models are available; all use the same canopy and the same lamp assembly and each is equipped with all necessary wiring, sockets and auxiliary switches ready for installation of the two lamps. The canopy used is 13¾ in. wide, 20 in. long and 5 in. deep. The Model 74-FA-122 unit shown is designed for bench or table installation.

"Ellwood" Safety Shin Protectors

Shin guards made of fiber and formed to fit the leg are offered by the Ellwood Safety Appliance Co., 217 Fountain Ave., Ellwood City, Pa. Three horizontal ribs are employed to increase the strength and rigidity of each guard. At the top and bottom of each guard is fitted a molded sponge rubber pad which cushions the guard against the wearer's clothing and acts as a shock absorber.

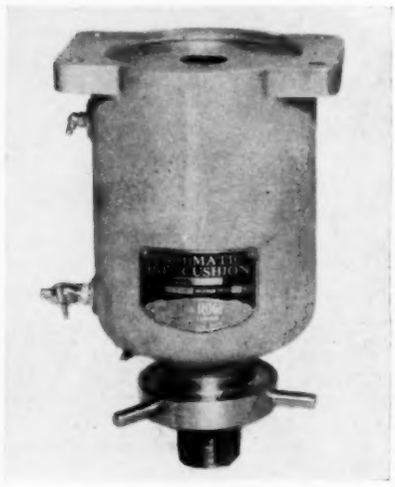


"Ready" Press Feeder

Feed of strip material to punch presses is positive and accurate, without backlash, when using the "Ready" feeder and straightener offered by Condenser Cleaners Mfg. Co., 422 First Ave., Pittsburgh, Pa. The unit feeds close to the die, so that it can be used on short strips without waste. An automatic clutch releases if the strip sticks in the die, stopping the feed without bending the strip. The only connection to the punch press is an arm connected to the press ram to lift the lever on the up stroke of the press.

Rogers Model "B" Die Cushion

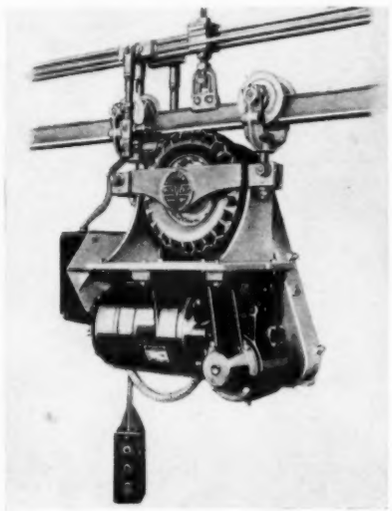
The Dayton Rogers Mfg. Co., 2830 S. 13th Ave., Minneapolis, Minn., offers the Model B universal pneumatic die cushions with hollow steel stems in seven sizes, with piston diameters ranging from 4 to 14 in. The hollow piston stem design allows scrap slugs to fall through the cushion



cylinder and makes these cushions adaptable to both combination blanking, drawing and piercing, as well as to stripper control action on all compound blanking and piercing dies.

Louden "MotoVeyor"

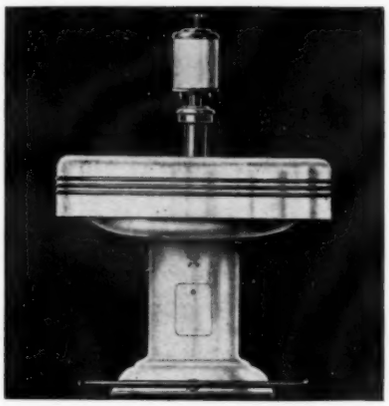
Developed for automatically transporting loads over an overhead track system, the "MotoVeyor" unit will negotiate inclines and will maintain a uniform speed even when going downgrade. Offered by the Louden Machinery Co., Fairfield, Iowa, this unit can be provided with a speed



range from 60 to 600 ft. per min. and can be furnished with a cab or step-on platform so that the operator can accompany the loads. A rubber tire is used on the drive wheel.

Severance Inside Burring Cutters

Teeth on the inside bearing cutters announced by Severance Tool Mfg. Co., 1520 E. Genesee Ave., Saginaw, Mich., are ground from the solid after the cutter has been hardened. Developed for burring pipe and tubing, these cutters also can be used for burring drilled and punched holes, as well as for removing fins from cast holes. They are available in four sizes, ranging from $\frac{1}{2}$ to $2\frac{1}{2}$ in. in diameter.

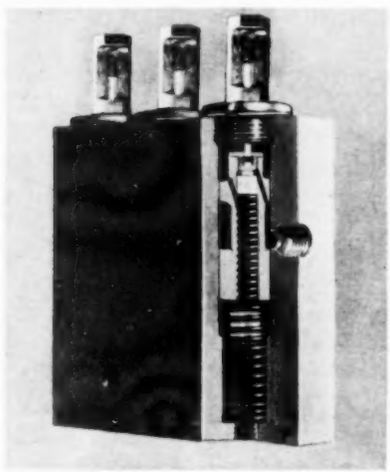


Bradley Wall-Type "Washfountains"

A line of wall-type, semi-circular wash fountains, at which three persons may wash at one time, have been announced by the Bradley Washfountain Co., N. 22nd and W. Michigan St., Milwaukee, Wis. These units are available in enameled iron or stainless steel with either hand or foot control. The DeLuxe Type *EF* washfountain shown is foot controlled and is equipped with a liquid soap dispenser. Other units are equipped with a cake soap tray.

Gordon Model H Lubricating System

Gordon Lubricators Div., Blaw-Knox Co., Pittsburgh, Pa., has developed the Model H lubricating system for grease lubrication of heavy-duty equipment. This system includes a Model H manually-operated grease pump which is used directly connected to one or more Model H measuring valves. The Model H valve shown is a simple positive displacement measuring valve in which the full grease line pressure from the



pumping unit is utilized in forcing the grease into the bearing. The springs in the valves are used only to return the pistons to their normal position after the grease line has been relieved of pressure. Each valve is adjustable to feed from 0 to 4/10 oz. per shot.

Hisey "Economy" Grinders and Buffers

Made in thirteen different models, ranging from $\frac{3}{4}$ to 5 hp. capacity, "Economy" grinders and buffers announced by the Hisey-Wolf Machine Co., Cincinnati, Ohio, are available in sizes for 8 x 1 in. up to 18 x 3 in. grinding wheels. These units are equipped with totally inclosed mo-

tors, adjustable wheel guards, dustproof ball bearings, adjustable tool rests, and can be fitted with eye shields and wheel dressers.

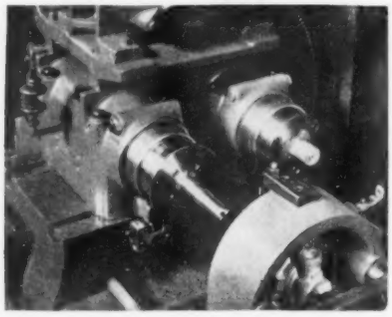
Moline Retracting Precision Boring Head

This automatic retracting precision boring head, offered by the Moline Tool Co., Moline, Ill., has been developed especially for single-point finish boring. This head provides precise adjustment for diameter of the bore and there is no necessity for stopping, reversing or indexing of the boring spindles, or shifting of the work, to avoid scoring upon withdrawal of the tools. The head consists essentially of two major parts, the uppermost being for attachment to the spindle and the lower part carrying the single-point tool with means for adjusting the tool. The lower portion of the head has a slight eccentric motion with respect to the upper part. When the cutter

comes in contact with the work it expands at once to the proper preset size and when the bore is completed the eccentric motion is reversed automatically and the lower portion of the head resumes its original position.

Ex-Cell-O Offers Retractable Spindle

A precision boring spindle which retracts the tool from contact with the work on the return stroke has been announced by the E-Cell-O Corp., 1228 Oakman Blvd., Detroit, Mich. This spindle is automatic in operation and has the same installation dimensions as standard boring spindle, hence it may be interchangeably installed on boring machines already



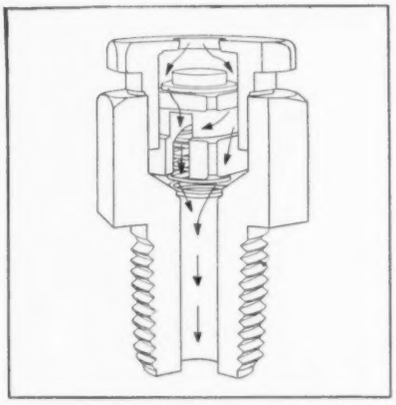
equipped with other types of Ex-Cell-O spindles. The retracting action is obtained through the action of two opposed hollow tapers, one concentric with the lengthwise axis of the quill and the other machined off-center a small amount.

G.E. Full-Voltage A.C. Motor Starter

The Type CR7006-D51 a.c. magnetic switch for full voltage motor starting, offered by General Electric Co., Schenectady, N. Y., is especially designed for use by machinery manufacturers who require small control equipment for built-in mounting. While it is small and compact, it has been designed in accordance with established standards of electrical clearances, mechanical strength and ratings. Basically, the switch consists of a line contactor, with interlock to provide under voltage protection and two isothermic temperature overload relays to protect the motor against overheating.

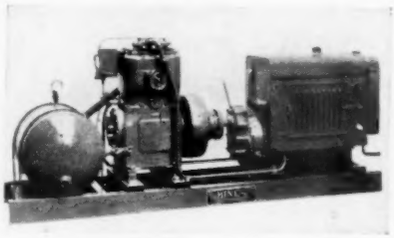
Alemite Button-Head Free-Flow Fitting

Bearings requiring large amounts of lubricants can be filled rapidly with the large free-flow, button-head fitting announced by the Alemite Div., Stewart-Warner Corp., 1826 Diversey Parkway, Chicago, Ill. The usual valve core has been replaced with one which has a flat face and seat and which, when open, offers practically no impediment to the free flow of the lubricant. Lubricant flows unobstructed through the center of the spring and not through its compressed coils. Bodies of these fittings are hardened to withstand rough treatment and severe service.



Binks Portable Compressor Unit

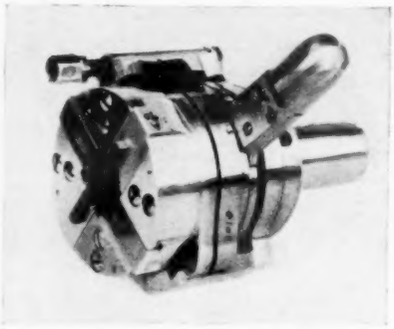
Both the gasoline engine and the compressor of this large portable unit built by Binks Mfg. Co., 3114-26 Carroll Ave., Chicago, Ill., use the same water for cooling. Compressor is of the twin-cylinder type and has a displacement of 55 cu. ft. per min.



Gas engine is rated at 6 hp. Engine, compressor and air tank are mounted on skids and can be placed on a truck for moving from one spray painting job to another.

H & G Die Heads

An improved line of H & G insert chaser die heads for use on hand screw machines and turret lathes has been developed by the Eastern Machine Screw Corp., 20 Barclay St., New Haven, Conn. Made in what are known as the No. 101, 102 and 103



sizes, these heads use the same insert chasers as other styles and all three sizes of the heads use the same chasers where the sizes are within their rated capacity. The heads may be tripped either by pull-off or by front end contact. The No. 103 size has a range from $\frac{1}{4}$ to $1\frac{1}{4}$ in. in long threads and up to $1\frac{1}{2}$ in. diameter in short threads.

White No. 8 Blowpipe

A radial grid tip is used in the No. 8 blowpipe developed by the S. S. White Dental Mfg. Co., 10 E. 40th St., New York, N. Y. This blowpipe is recommended for general purpose soldering and brazing. It is regularly supplied with three carburetors for manufactured gas, natural gas, and mixtures of these gases. Two inter-

LAPPED FITS ELIMINATED

Gas Cock Bodies and Plugs Now Produced On Ex-Cell-O Precision Boring Machines

The American Stove Company, of St. Louis, a year ago developed its improved "Simmer Set" gas cock. In tooling for this job, the company wished to improve its method over the former manufacturing set-up which produced tapered gas cock body and plug seats by reaming and turning, and then lapping the parts together. The company was not satisfied because this method left abrasive embedded in the seats that was detrimental to the operation of the gas cocks, and because parts were not interchangeable.

Four Ex-Cell-O Precision Boring Machines were therefore installed, for boring the bodies and turning the plugs. Proper fits are now obtained without lapping. To check fit, a thin narrow strip of prussian blue is applied the full length of the plug; when turned in a body, the plug shows almost 100% contact. The clean, smooth precision bored and turned finish insures minimum wear in operation. Selective assembly is not necessary, because any plug is a mate for any body.

Other manufacturers of tapered valve bodies and plugs are likewise reducing their production cost and improving the quality of their products with Ex-Cell-O Precision Boring Machines. We would like to send you data on several such installations, and to show you the results that can be secured in your plant.

EX-CELL-O

DRILL JIG BUSHINGS. GRINDING SPINDLES. HYDRAULIC POWER UNITS. PRECISION BORING AND FACING MACHINES. PRECISION THREAD GRINDERS. COUNTERBORES. BROACHES. CARBIDE TOOL GRINDERS. CARBOLOY TIPPED TOOLS. SPECIAL HIGH PRODUCTION MACHINES. GROUND FORM TOOLS. PRECISION PARTS. MILLING CUTTERS

EX-CELL-O CORPORATION, 1224 Oakman Blvd., Detroit, Mich.

Please send me, without obligation, data on precision boring and turning tapered bodies and plugs.

Name ..... Title: .....

Company .....

Address .....

changeable tips are available. The smaller, supplied as standard equipment, is suitable for all ordinary soldering and brazing operations; the larger is for use where alloys must be melted rapidly.

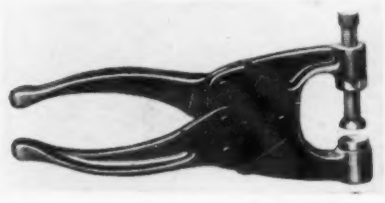
G.E. Mercury-Button Small Limit Switch

The No. CR9440-E1A single-pole limit switch announced by General Electric Co., Schenectady, N. Y., uses a mercury-button contact mechanism to open and close the circuit. This device is suitable for use where the force available for operation of the switch is small, inasmuch as the only

force required to operate the switch is that necessary to lift the light-weight molded lever. An atmosphere of hydrogen in the mercury-button element prevents burning and corrosion.

Knu-Vise Offers Toggle Pliers

Pressure generated by the compound levers in the toggle pliers offered by Knu-Vise Products Co., Inc., 6430 Cass Ave., Detroit, Mich., makes it possible to exert considerable pressure between the jaws of these pliers, and permits their use in the place of small C clamps. Use of these pliers eliminates the possibility of the clamp "walking" as is possible when using screw-type C clamps.

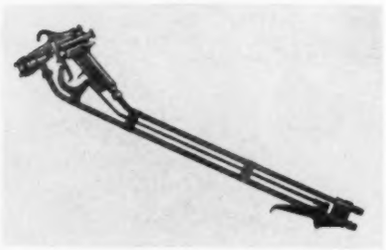


Ohio 0.01 Hp. Capacitor Motor

This 0.01 hp. permanent split-capacitor type electric motor, developed by The Ohio Electric Mfg. Co., 5914 Maurice Ave., Cleveland, Ohio, measure $3\frac{3}{4}$ in. square by $4\frac{1}{4}$ in. long and operates vertically at 1,700 r.p.m. By changing the capacitor the rating of this motor can be changed to range from 1/50 to 1/20 hp. with speeds of 850–1,700 or 3,400 r.p.m.

DeVilbiss High-Speed Extension Spray Gun

The handle of the high-speed extension spray gun announced by the DeVilbiss Co., Toledo, Ohio, is designed



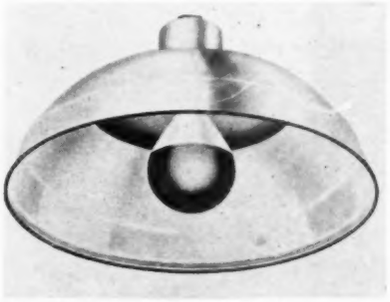
so as to make its operation as simple as possible. The arrangement consists of a Type MBE extension handle fitted to a standard Type MBC gun. Nozzle of the gun is tilted at a 45 deg. angle from the line of the handle to facilitate spray painting walls and ceilings. Standard lengths are 3, 4, 5, 6, 8 and 10 ft.

Noggle "Add-A-Bin" Unit Storage System

The "Add-A-Bin" storage system offered by Noggle Products Co., Ann Arbor, Mich., consists of unit bins sold separately and assembled by the user to fit his individual needs. The bin housing may be mounted on a wall, bench or cupboard. Bins are so balanced that the weight of the contents, no matter how light, causes it to close automatically when the mechanic's hand is removed. If, when open, the bin is lifted slightly, it will lock open, or it may be lifted higher and pulled out to remain open horizontally for cleaning. Combinations can be arranged as desired.

Westinghouse "RLM" Silver Bowl Diffuser

The RLM standard silver bowl diffuser developed by Westinghouse Electric & Mfg. Co., for use with 300 and 500 watt silvered bowl lamps is recommended for general lighting of low bay areas. The unit consists of a dome shaped porcelain-enameled reflector, an inner aluminum reflector and a socket assembly.



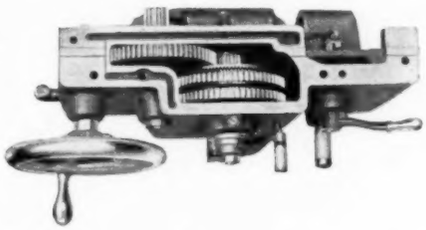
Yale "Cable King" Electric Hoist

Made in capacities ranging from $\frac{1}{4}$ to 6 tons, the "Cable King" wire rope electric hoist offered by Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia, Pa., regularly is supplied for hook or lock suspension, plain or hand geared I-beam trolley suspension, special monorail systems, motor trolley suspension and for winch type floor mounting. These hoists can be powered with a.c. or d.c. motors, which range in size from

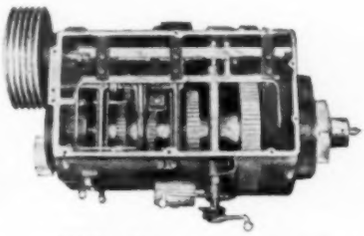
A *backward* glance with a *forward* look!

The years ahead hold but the *promise* of progress — the years behind the proof of their fulfillment. Take a backward glance at these highlights of achievement by LeBlond. In reality these milestones are a forward look for they are the promise of continuing progress—backed by the proof of past performance. • • •

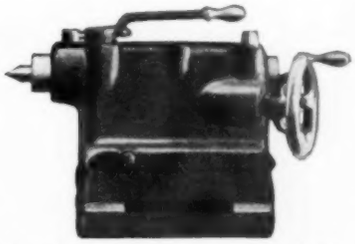
1915 marked the end of the troublesome friction clutch and promoted to its place the positive clutch which

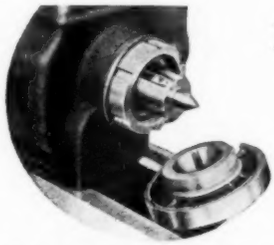


holds, but can be disengaged with a finger touch. Loose running gears were scrapped in 1923 to be replaced by gears on splined shafts running on fixed bearings.

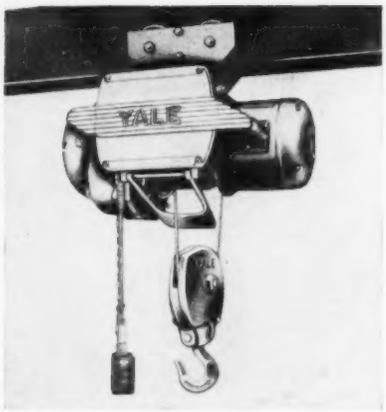


1930 brought the hardened way with its signal contribution to long life and undeviating accuracy. Production efficiency went up in 1934 when LeBlond introduced the positive lock tail stock and the worm drive, to be followed in 1935 with the 3-bearing spindle and Taper lock standard spindle nose—while flame hardening carried the torch of LeBlond progress in 1937. These milestones of achievement thru 50 plodding years are a trustworthy promise that in the years ahead LeBlond Tools will continue to pacemake the continuing demands of MAIN STREET!





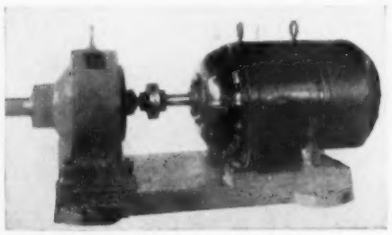
LeBLOND
CINCINNATI, OHIO
U.S.A.



¾ to 10 hp. in the various capacities. Design of these units incorporate positive provisions for air cooling the load brake and main gear assembly.

Smith Type HM Speed Reducers

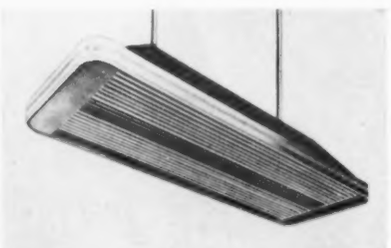
Type HM differential speed reducers offered by Winfield H. Smith, Inc., Springville, Erie Co., N. Y., are arranged so that it is possible to obtain



a reduction of 20,000 to 1 in a housing only 7¼ in. in diameter and 8⅜ in. long. These speed reducers are equipped with anti-friction bearings and include heat treated alloy steel gears.

"Visualite" Tube Lighting Fixture

Designed for high intensity illumination, color matching and inspection work, the lighting fixture shown contains 80 ft. of fluorescent luminous tubing. Made by the Visualite Corp., Lima, Ohio, this unit is offered in

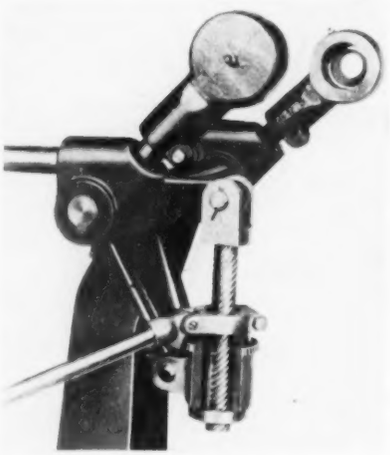


three sizes for 200 and 300 watt consumption and operates on 110 volts, 60 cycle, single phase current.

Stearns Portable Drill Stand Magnet

Use of the high-duty portable drill stand magnet announced by the Stearns Magnetic Mfg. Co., Milwaukee, Wis., permits the unit to be spotted in almost any required position for drilling, tapping, reaming, hole sawing, nut running or similar operations. With the drillstand mounted on the magnet, the operator is able to increase drilling speed with-

out fatigue. The magnet weighs 40 lb. and has a pull of 900 lb. It is 8½ in. in diameter and can be used on a.c. or d.c.



Berkeley Offers "Tension-Trol" Drive

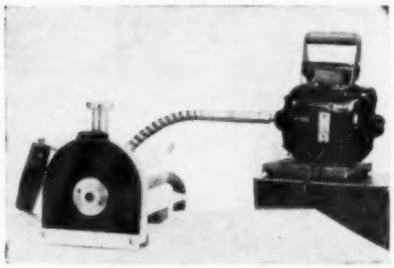
Equal belt tension on different steps of a cone pulley drive can be provided with the "Tension-Trol" control unit developed by the Berkeley Engineering Co., 1381 E. 17th St., Cleveland, Ohio. In this device a position-locking nut, operating on a fast lead screw, provides instant adjustment of the pulley centers. It is available in several sizes.

Lewis-Shepard Offers Cylinder Truck

A truck designed for handling heavy cylinders of anhydrous ammonia, chlorine, and other gases, is offered by the Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Boston, Mass. By means of a frame and clamp device on this truck, the operator may select a tank from the storage line without disturbing other tanks. With a push of a lever the tank is clamped to the truck frame. Cylinders up to 15 in. in diameter and 53 in. long can be handled.

Hampton Model E A.C. Arc Welder

The Model E a.c. arc welder offered by the Hampton Electric Tool Co., 700 Walnut St., Edgewood, Pittsburgh, Pa., has a welding range of 20–280 amp., and will take any electrode from $\frac{1}{16}$ to ¼ in. in diameter. It has a single dial control for welding amperage. It operates on any standard 110 or 220 volt a.c. circuit. Over-all dimensions are 20 x 13 x 23 in.

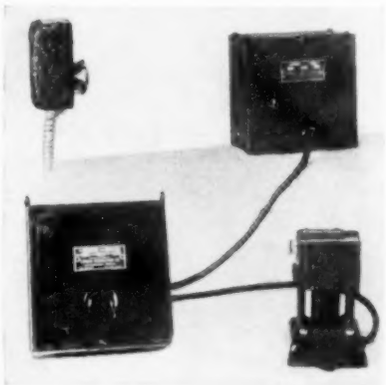


"Stevenson" Plane

The improved Model D "Stevenson" rotary plane for heavy-duty finishing of metal surfaces, offered by the Hardware Specialty Co., Withee, Wis., uses a 1 x 6 in. grinding wheel. This wheel is driven through a flexible shaft by a ½ hp. motor at 3,450 r.p.m. Adjustment for depth of cut is claimed to be accurate to within 0.005 in. Weight of the toolhead is 2¾ lb.

Lipman Type PC-3 Electric Counter

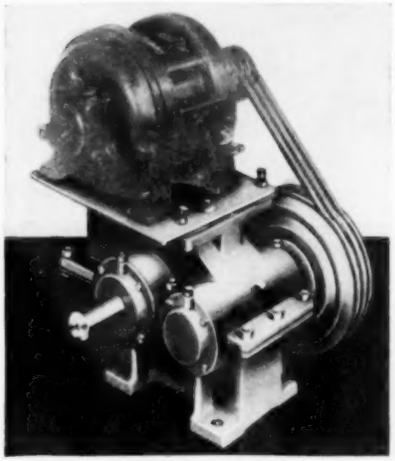
The Type PC-3 counting unit offered by Lipman Engineering Co., 415 Van Braam Street, Pittsburgh, Pa., is supplied complete with photo-electric cell relay, light source, power supply and



counter. The polarized plug connections for cables increase the usefulness of the equipment on multiple installations, permitting the cell amplifier and relay to be removed or replaced within a few seconds. This unit is guaranteed to count accurately as many as 36,000 units per hour.

S-A "Saco" Reducers

"SACO" speed reducers offered by the Stephens-Adamson Mfg. Co., Aurora, Ill., can be used with any standard, full-speed motor, to give required output speed. The motor support is adjustable for V-belt drive, permitting sheaves to be replaced to suit changes in required output speed. Range of output speed varies from 13.2 to 172 r.p.m. All shafts are mounted in precision ball bearings and the precision-cut helical steel gears operate in a constant bath of oil.



G. E. 100-Watt Fluorescent Lamp

General Electric Vapor Lamp Co., Hoboken, N. J., has developed a 100-watt fluorescent lamp to supplement its line of industrial lighting units. This lamp is a tubular light source having a 4 ft. effective length.

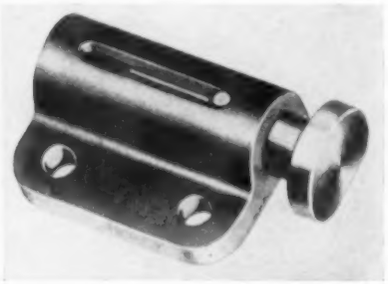
B. & S. "Motorpump"

Particularly suited for supplying coolant for machine tools, light machinery and other installations where a large volume of liquid is required at a low head, and where dirt or abrasive may be present in the liquid, the No. 212 centrifugal "Motorpump" offered by Brown & Sharpe Mfg. Co.,

Providence, R. I., can be supplied with a direct-connected ½ hp. motor wound for one of a number of voltages.

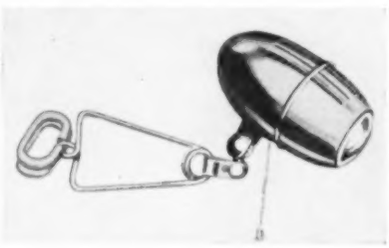
Knu-Vise Spring Stop Gages

Developed for use as standard components in dies, tools and fixtures, the spring stop gages offered by Knu-Vise Products Co., Inc., 6430 Cass Ave., Detroit, Mich., have ⅞-in. diameter chamfered heads. Pressure of the $\frac{5}{16}$-in. spring is sufficient to push strip stock or semi-finished parts tightly against a positive locator.



Brown "Personalite" Lighting Unit

The industrial model "Personalite" lighting unit offered by Brown Electric Co., 69 Morton St., Rochester, N. Y., uses a 60 watt frosted bulb and a condenser lens to direct the light beam. This arrangement is claimed to eliminate glare, even when



working close to the light. A spring clip base and double ball-socket joint permits mounting this unit wherever necessary.

SKF "Triple Seal" Bearing Protection

SKF Industries, Inc., Front St. & Erie Ave., Philadelphia, Pa., have developed a "Triple Seal" which effectively protects bearings against lubricant leakage, dust, dirt and moisture. This seal consists of two split piston

rings on each side of the housing. These are grooved on the outside of the diameter to form a labyrinth seal with the two end bores of the housing. Each ring has an inward tension that enables it to turn with the shaft. Two rings are mounted on the shaft at both sides of the housing with the splits 180 deg. apart to prevent lubricant leakage. The inner ring serves as a flinger, and the outer ring keeps dirt and other foreign substance from entering the housing. The seals are free to locate themselves axially whenever shaft expansion occurs.

H.-V.W.-M. No. 20 Galvanizing Flux

The No. 20 flux, recommended for use both as a flux wash and, in crystal form, for making fusions on molten zinc, is offered by the Hanson-Van Winkle-Munning Co., Matawan, N. J., to replace both the sal-ammonia and the muriatic acid fluxes used for hot galvanizing. This flux is a form of zinc-ammonium-chloride and, when dissolved in water, becomes what is known as a neutral flux wash. It is claimed that the use of this flux results in a smoother, more ductile and more adherent zinc coating, together with large reductions in dross production.

Fafnir Type W-W Woodworking Bearings

Designed to permit high-speed operation with comparatively small power units, the Type W-W Woodworking ball bearings announced by the Fafnir Bearings Co., New Britain, Conn., are especially suitable for woodworking machinery. These bearings have a machined bronze retainer. Duplex bearings combine large balls and deep races for high load capacity and shock resistance.

Davis Fireproof Emergency Blanket

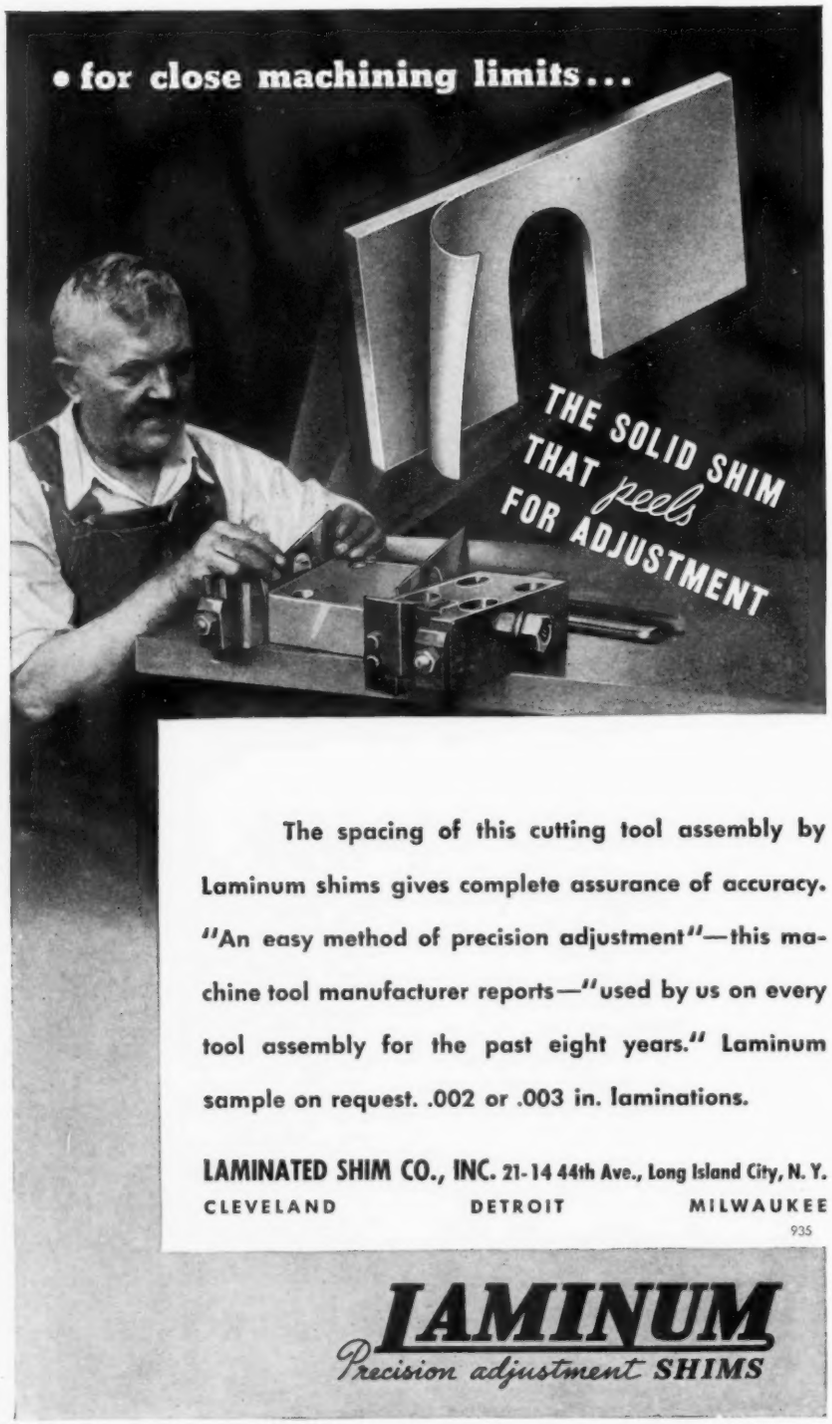
Wound on a vertical roller so that it can be wrapped tightly around one's body in a few seconds without assistance, a fireproof blanket being marketed by the Davis Emergency Equipment Co., 55 Van Dam St., New York, N. Y., offers protection to workers whose clothes may catch on fire. It is necessary only for the worker to thrust an arm through a catch-rope attached to the exposed edge of the blanket and, turning rapidly, wrap the blanket closely around him to extinguish the flames.

A. G. F. "Machlet" Hardening Method

An improved method for hardening high-speed steel tools has been announced by the American Gas Furnace Co., Elizabeth, N. J. Developed by A. W. Machlet, this method is intended especially for work where scaling is not permissible and where the tool must be hard up to the surface. Various grades of high-speed steel may be treated in the same charge and at the same temperature. This method includes a long pre-heat followed by a somewhat rapid heating to a final temperature.

Driver-Harris Offers Z-Nickel Products

Z-nickel is being fabricated by Driver-Harris Co., 942 Book Bldg., Harrison, N. J., in cold-drawn rods, wire and cold-rolled strip in a wide range of sizes. Such forms are available in soft, half-hard and full-hard tempers to meet a wide range of fabrication and application requirements.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The spacing of this cutting tool assembly by Laminum shims gives complete assurance of accuracy. "An easy method of precision adjustment"—this machine tool manufacturer reports—"used by us on every tool assembly for the past eight years." Laminum sample on request. .002 or .003 in. laminations.
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TRADE PUBLICATIONS

ADJUSTABLE SHEAVE Leaflet No. 2333, issued by the Allis Chalmers Mfg. Co., Milwaukee, Wis., illustrates the "Texsteel" adjustable combination sheave.

ALLOY STEELS Research Paper No. RP 1115 published by the National Bureau of Standards, U. S. Department of Commerce, discusses methods for the determination of the oxygen content of many types of alloy steels. Copies may be obtained from the Superintendent of Documents, Washington, D. C. Price, 10 cents each.

BEARINGS The Bower Roller Bearing Co., 3040 Hart Ave., Detroit, Mich., has published an engineering journal which includes over 100 pages of technical data, engineering drawings and other essential information relating to the design, application and functioning of roller bearings.

BORING TOOL A folder issued by the Eclipse Counterbore Co., 7410 S. Aubin Ave., Detroit, Mich., describes a line of "Mikro-Lok" self-locking micrometer-adjusting boring tools.

CASTINGS A pamphlet issued by the Chicago Hardware Foundry Co., North Chicago, Illinois, illustrates equipment and methods used in producing iron, steel and non-ferrous alloy castings.

CLEANING The contributions of "Oakite" cleaning methods to industrial safety are outlined in a booklet offered by Oakite Products, Inc., 14 Thames St., New York, N. Y.

COMPRESSOR Form No. 3072, offered by the Ingersoll-Rand Co., Phillipsburg, N. J., contains detailed information regarding the Type XVO heavy-duty diesel engine driven air compressor.

COMPRESSORS Bulletin No. H-260-B8A, offered by the Worthington Pump & Machinery Corp., Harrison, N. J., discusses Types VA and VA-2 V-type air compressors.

COMPRESSORS Features of air- and water-cooled air compressors are contained in a folder released by the Quincy Compressor Co., Quincy, Ill.

CYLINDER TRUCK Features of the cylinder-handling truck offered by Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Boston, Mass., are described in Circular No. 237.

ELECTRIC FURNACES A folder issued by the Ajax Electrothermic Corp., Trenton, N. J., discusses high-frequency industrial electric furnaces.

DIAMOND TOOLS "Koebelite" diamond wheel dressing tools are discussed in a pamphlet issued by the Koebel Diamond Tool Co., 1228 Oakman Blvd., Detroit, Mich.

DRUM MAKING The Niagara Machine & Tool Works, 637–697 Northland Ave., Buffalo, N. Y., illustrates a line of drum making machines in Bulletin No. 82.

FURNACE Applications of the "Char-Mo" industrial heat-treating furnace are discussed in a folder released by the Surface Combustion Corp., Toledo, Ohio.

FURNACES A complete line of small furnaces, burners, forgers, iron heaters, rivet heaters, pyrometers and blowers are described in a 28-page bulletin published by the American Gas Furnace Co., Elizabeth, N. J.

GRINDER A folder released by the Hill Clutch Machine & Foundry Co., 6400 Breakwater Ave., Cleveland, Ohio, reveals features of the heavy-duty horizontal precision surface grinder.

HARD-FACING A revised folder, "Hard Facing with Haynes Stellite Rod (Oxy-Acetylene Process)," con-

their greater factor of safety insures maximum service

T-J HYDRAULIC CYLINDERS

not only "look the part", they ARE capable of handling the tougher jobs. They are designed throughout to have NOT LESS THAN a factor of safety of 8 for use with pressures of 1000 lbs. per square inch. The heads are steel. The tie rods and piston rod are alloy steel. Pistons of greater width provide better alignment.

These and additional features of construction of T-J Hydraulic Cylinders are described in catalog No. H-37. This also contains engineering information to assist you in making the proper selection.

TOMKINS JOHNSON

615 North Mechanic St., JACKSON, MICH.

Agents in Principal Cities.

tains condensed data and procedure for hard-facing steel by the oxy-acetylene process. A revised folder presents comparable data for hard-facing by the metallic arc process. Both publications are issued by the Haynes Stellite Co., Kokomo, Ind.

HOISTS The Northern Engineering Works, 210 Chene St., Detroit, Mich., includes ratings and dimensions of standard "Hi-Lift" hoists in Catalog No. H-106.

INSTRUMENTS Control instruments for the protection of gas-fired ovens and furnaces are described in Bulletin No. 521, released by the Bristol Co., Waterbury, Conn.

INSTRUMENTS The General Radio Co., Cambridge, Mass., includes specifications of electrical testing and measuring instruments in Catalog K.

METAL CLEANING G. S. Blakeslee & Co., 19th St. and 52nd Ave., Chicago, Ill., has issued a folder describing several types of metal-parts washing machines.

METAL FINISHING The "Thermoil-Granodine" process of protecting finished parts against wear and corrosion is discussed in a folder released by the American Chemical Paint Co., Ambler, Pa.

PUMPS Bulletin No. W-318-B1B, released by the Worthington Pump & Machinery Corp., Harrison, N. J., includes design features and specifications of Types UW and UX multi-stage centrifugal pumps.

PUMPS Single-suction, multi-stage pumps are described in a 36-page illustrated Catalog No. B-5 published by the DeLaval Steam Turbine Co., Trenton, N. J.

PUMPS The Worthington Pump & Machinery Corp., Harrison, N. J., describes a line of vertical single-acting general service pumps in Bulletin No. W-423-B5.

SHOPS Booklet No. 88, published by the South Bend Lathe Works, 279 E. Madison St., South Bend, Ind., entitled "Modern Industrial Shops," illustrates the use of precision lathes in the shops of nationally known manufacturers.

SPECIAL TOOLS An 18-page illustrated catalog, published by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y., discusses a line of special pneumatic airplane tools.

STEEL SHEETS A 12-page folder released by the Republic Steel Corp., Cleveland, Ohio, discusses the properties and uses of "Galvannealed" steel sheets.

SWITCHES A series of bulletins released by the Micro Switch Corp., Freeport, Ill., provides specifications and recommendations concerning "Micro" switches for machine tool and other industrial applications.

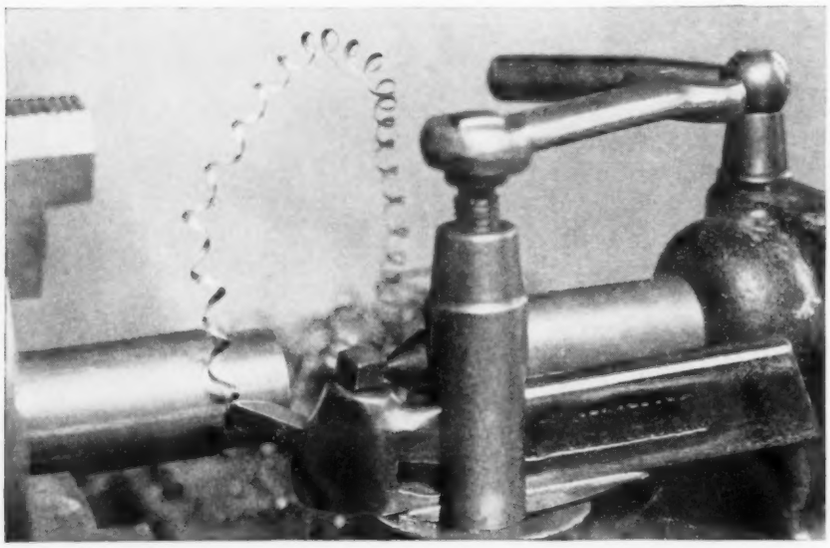
SWITCHES Bulletin No. 517, issued by the Bristol Co., Waterbury, Conn., describes a line of air switches for the control of electrically- or air-operated valves.

THREADING A 12-page pamphlet released by the Landis Machine Co., Waynesboro, Pa., illustrates threading machines, die heads and collapsible taps.

TOOLS Catalog No. 33, published by the Brown & Sharp Mfg. Co., Providence, R. I., contains 480 pages of data and specifications concerning a complete line of hand tools and machine tool cutters and accessories.

TRANSMISSION The "Select-O-Speed" variable speed transmission is describer in Folder No. BR-938, offered by the Ideal Commutator Dresser Co., 1236 Park Ave., Sycamore, Ill.

UNIT HEATERS Bulletin No. S-327, now being distributed by the Trane Co., La Crosse, Wis., contains 20 pages of illustrations and data concerning several types of industrial unit heaters.



Savings of 25% to 50%

in Machining of Steel—New Ledloy Bulletin Tells How

An automobile parts maker has reduced normal machining time on an operation from 11 seconds to 3½ seconds by substituting Inland Ledloy 1120 for regular SAE 1120.

A household utilities manufacturer increased production from 918 to 1,330 pieces per hour by changing from SAE-X1315 to Inland Ledloy 1115. He reported excellent finish.

In the making of a carburized worm shaft, Inland Ledloy has cut machining costs $47.85 per ton of steel used. Tool life is increased, in many cases as much as 200 per cent.

You, too, can make such savings in costs and obtain the advantages of increased production by using Inland Ledloy, if any product you make requires extensive machining.

You can obtain Inland Ledloy in any standard analysis. Its physical properties, heat-treatment, etc., are exactly the same as for ordinary steel of the same classification.

Write for the New Inland Ledloy Bulletin

INLAND STEEL COMPANY

38 So. Dearborn St., Chicago, Ill.

VALVES The Edward Valve & Mfg. Co., East Chicago, Indiana, has issued an 8-page folder discussing valve manufacture.

WELDING The Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio, has published Bulletin No. 401-A, which discusses procedures for welding all metals used industrially and lists auxiliary equipment and accessories.

NEW BOOKS

WELDED STEEL CONSTRUCTION —*By Robert S. Hale, construction engineer, U. S. Treasury Department. 170 pages, 5½x8½ in. Indexed and illustrated. Clothboard binding. Published by the Pitman Publishing Corporation, 2 West 45th St., New York, N. Y. Price,* $3.00.

The removal of building code restrictions against welding construction is certain to give this method of steel fabrication a scope in keeping with improvements in its technique. Not many years ago, welding was looked upon as merely a "tacking" together of two metal parts in sort of a makeshift method; welded joints were looked upon with suspicion.

But welding has proved itself by cross-section cuts, by notch-bar and tension tests, by metallography and by the penetrating eye of the X-ray. Mr. Hale tells what welding has done and can do particularly as applied to steel construction. He discusses principles of design and applications in practice. He weighs cost against results achieved. He includes in his text many working sketches, photographs and tables of data. An appendix contains additional working information including a rather complete bibliography of the subject.

SEEN AND HEARD

JOHN R. GODFREY

Another Lathe with Extended Spindle

Lathe spindle extensions are not always because of a badly worn bed due to constant use near the headstock, as I mentioned not long ago. I saw another instance soon after where the spindle extension was very short, just long enough to get in a considerably larger bearing than the lathe maker had provided in his original design. A substantial steadyrest was bolted solidly to the bed just in front of the main bearing to carry the spindle extension which was large enough to enable the lathe to handle much heavier work than was originally the case. Needless to say this was a jobbing shop handling a great variety of work in a small space.

High Maintenance Costs

One of the expenses that seldom receives the attention it deserves is the cost of maintenance of odd or antiquated equipment. This is equally true of railroad locomotives and rolling stock, textile machinery or machine tools. One railroad shop superintendent told me that he had to carry over $500,000 worth of spare parts to keep his locomotives running because there were 75 different types that came to him for repairs. In some cases there were only two locomotives of a kind, but he had to have spares for them just the same.

The same is true of buses and trucks. This is the reason fleet owners stick to one model or make for a long time instead of ordering new designs with every addition. It may be cheaper to discard obsolete mod-

Announcement!

Intensive research has just completed important improvements in the field of heavy-duty gear and bearing lubrication.

As in 1931, D. A. Stuart Oil Co.'s pioneer development, "STURACO" EP Gear and Bearing Lubricant, again widens the field between it and competitive products.

This leadership is emphasized by the original factual data contained in the new twelve-page illustrated bulletin called "Sturaco Bulletin–No. 5."

A copy will be mailed free, upon request, to designing and maintenance engineers of industrial machinery. Write today for your copy.

D. A. Stuart Oil Co., Ltd.

Established 1865

2727 South Troy St., Chicago, U. S. A.

Branches and warehouses in principal industrial cities

els when new ones have proved their worth than to carry spares enough to keep the old ones in operation. Standardized equipment pays in many ways. It does not mean lack of progress. It simply means sticking to one model until a new one proves its worth—and then standardizing on that for a like period. A slight saving from a small number of new machines may easily prove a loss in extra cost of maintenance.

Another Incentive Plan

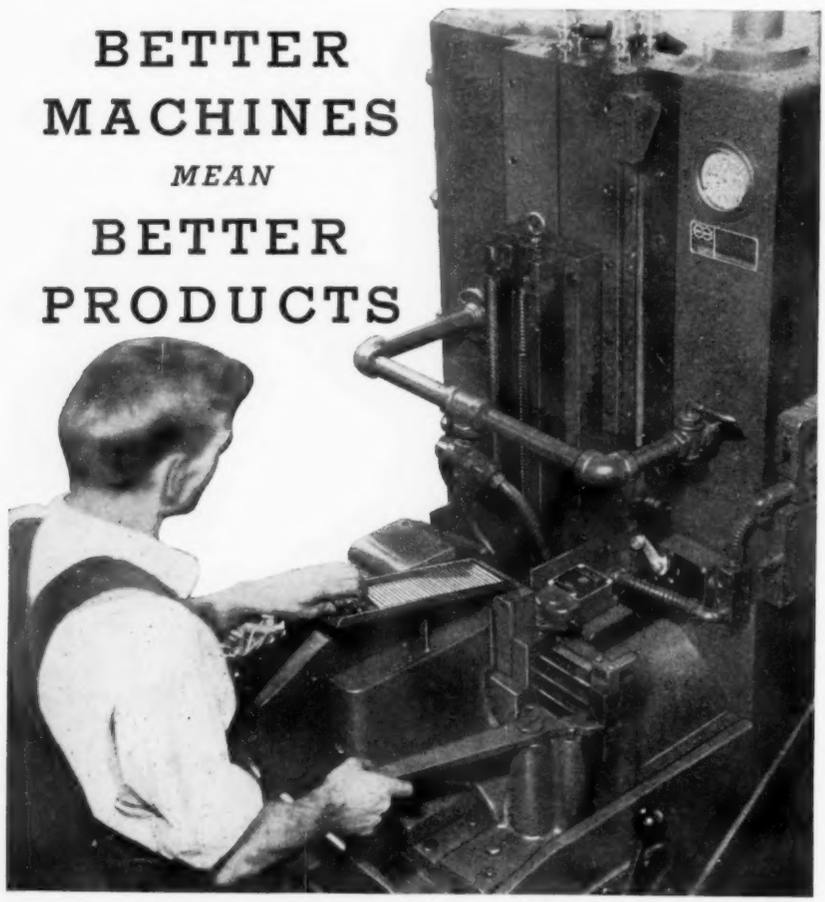
A well known manufacturing concern recently staged an "at home" that was different in several ways. Although primarily intended for the families of the employees to show the folks at home just what Bill and Jim and Mary did to earn the jack in their pay envelopes by letting them wander through the shop, they staged a working exhibition. They ran a night shift and had the machines all in operation. Not only the machines were running but the men and women were turning out regular products right before their eyes. They saw the rapidly moving machines and just how fast the operators had to move to keep things running. Every worker's family went home with a higher regard for the ability of the breadwinner, whose stock went up at home as a result.

There was also another angle that no one had foreseen. The production went up also! Instead of slowing down the output while Bill and Jim and Mary showed their admiring families how clever they were, the production for the shift went up about 30 per cent—believe it or not. One girl assembler, who had a record no one had ever even approached, beat her own output appreciably. There is only one answer to the phenomenon. The men and women showed their folks *how* they worked and also how fast they could make their machines turn out the products. This might not work out in all cases, but it adds another to the list of incentives for the industrial engineer to think about.

The Human Side

The need for a human side in shop executives, as shown by the old foreman, reminds me of a chat with the general manager of a large concern a few years ago, which shows that the need is just as urgent in the white collar class. This firm had a fifteen minute recess about 11 a.m. when the male office employees exercised in a gymnasium. The interesting part to me was that every one had to strip to his underclothes. When asked for the reason the manager said "This exercise period includes department heads and the lowest paid clerks. We make 'em all strip because even the snootiest boss can't high hat anyone in his B.V.D's." Which may be something to think about!

BETTER MACHINES *MEAN* BETTER PRODUCTS



● The trend in American Industry is sharply toward giving better value—by cutting costs, improving parts or the whole, by smoothing and speeding the way to production.

Only constant alertness—sharpest scrutiny of production methods can give a producer a place in this marching parade.

Production men, of *all* men, should know the Oilgear Story . . . how a steady stream of improvements both major and minor keep Oilgear Presses, Broaches, etc. at the head in these important production-tool fields.

Let us show you Oilgear's record of superiority in America's leading industrial plants. Write for further information. THE OILGEAR COMPANY, 1301 W. Bruce St., Milwaukee, Wis.

OILGEAR

BROACHING MACHINES AND PRESSES

60 YEARS AGO

Worcester, Mass., December 3, 1878.

Editor, American Machinist—The machinery business which forms so large a part of the industry of this city does not improve to the extent that was hoped for at the beginning of the present year, yet there is "light ahead" and we have, let us hope, seen the darkest season pass away. Buyers of machinery, who were accustomed before the Panic of 1873, to come to Worcester from all parts of the country have become scarce, probably because their purchases each amount to so little that the business can well be transacted by mail. . . . The bulk of the machine tool business here is now being done by David W. Pond and P. Blaisdell &

Co. Mr. Pond has the largest shop, and employs about 100 men. . . . The Lathe & Morse Tool Co. is an old concern in the machine tool line, with a good reputation for both business credit and quality of their productions, but their shop has been very quiet for several months.

J. S. Wheeler & Co., who were formerly prominent among the machine tool makers, now do scarcely anything but jobbing. Mr. C. Whitcomb is building some iron planers, a tool he has made a specialty for many years, and with which he has been very successful.

Also appearing in the December, 1878, number of *American Machinist* was the following editorial:

Does the Increasing Use of Machinery Depress the Condition of the Working Classes?

When labor cannot find full employment, many reasons for it are offered, and it is not strange that some of them are positively erroneous, and when strongly urged, exert a mischievous influence. The opposition to labor-saving machinery seems to have developed itself more boldly within two or three years than ever before, and it is important to inquire whether this opposition is based upon any good foundation. Almost every one of the material necessities and luxuries of life is in some measure dependent upon machinery for its production. . . .

The use of machinery tends to lessen the hours of labor as well as to ease its burden. Not many years ago twelve hours constituted a day's work for mechanics and artisans; but with the advantages afforded by the march of mechanical improvement it was shortened by two hours, and we confidently anticipate, in the not far distant future, that throughout this great progressive nation, eight hours will be fixed upon, by mutual consent of employer and employed, as the limit of a mechanic's day's labor. This step in advance cannot be achieved by national or state legislation, but by the use of machinery that will enable the workmen to accomplish in eight hours what has hitherto required ten hours.

PATENTS

Printed copies of patents are furnished by the Patent Office at 10 cents each. Address the Commissioner of Patents, Washington, D. C.

November 22, 1938

Metal-Working Machinery

Cutting or Grinding Equipment. Henry J. Perazzoli, Philadelphia, Pa. Patent 2,137,306.

Apparatus for Die Casting Articles. Roy E. McIntish, New York, N. Y., assigned to Star Expansion Bolt Co., New York, N. Y. Patent 2,137,539.

Grinding Machine. Raymond A. Cole, Worcester, Mass., assigned to Norton Co., Worcester, Mass. Patent 2,137,644.

Pipe Working Machine. William A. Phillis, Warren, Ohio, assigned to Beaver Pipe Tools, Inc., Warren, Ohio. Patent 2,137,762.

Apparatus for Casting Metal Under Pressure. Karl Friedrich Wagner, Friedrichshafen, Bodensee, Germany. Patent 2,137,764.

Grinding Machine. Howard W. Dunbar, Worcester, and Herbert S. Indge, Westboro, Mass., assigned to Norton Co., Worcester, Mass. Patent 2,137,821.

Power Saw. Austin C. Elder, Canton, Ohio. Patent 2,137,893.

Drill. Dewey H. Goodman, Iowa Park, Tex. Patent 2,137,940.

Parts and Mechanisms

Overload Safety Device. William E. Schaefer, West Hartford, Conn., assigned to the Whitney Chain & Mfg. Co., Hartford, Conn. Patent 2,137,417.

Index Head. Millard Romaine, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co., Cincinnati, Ohio. Patent 2,137,462.

Degreasing Apparatus. Clarence F. Dibley, Detroit, Mich., assigned to Solvent Machine Co., Detroit, Mich. Patent 2,137,479.

Punch Retainer. Ferdinand Ziganeck, Detroit, Mich. Patent 2,137,557.

Screw and Nut Device. Leone Kamenarovic, Milan, Italy, assigned to Fabbrica Italiana Magneti Marelli Societa Anonima, Milan, Italy. Patent 2,137,573.

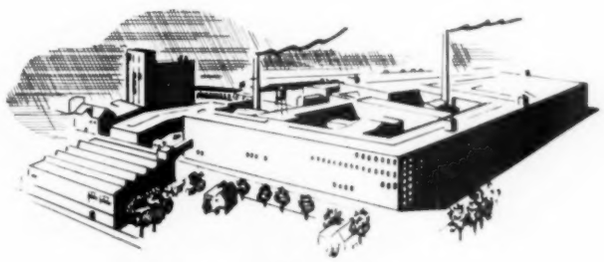
Vibrating Damping Device. Raoul Roland Raymond Sarazin, Saint-Prix, France. Patent 2,137,591.

Work Feeding Mechanism. Carroll E. Miller, Windsor, Vt., assigned to Cone Automatic Machine Co., Windsor, Vt. Patent 2,137,849.

Spindle for Automatic Lathes. Carroll E. Miller, Windsor, Vt., assigned to Cone Automatic Machine Co., Windsor, Vt. Patent 2,137,850.

Processes

Method of Making Wire Mesh. Herbert E. White, San Francisco, Calif., assigned to



Look Over

YOUR PLANT IN WOONSOCKET

It's completely equipped and running . . . ready for you to move in at any time. You can have any amount of space you want, up to 200,000 square feet, in any or all of 6 departments. And as you walk through the spacious, well-lighted buildings, you will see what looks like the latest machine tool show . . . more than 1,000 modern machines, to make anything you want *the way you want it made.* It makes no difference whether it's a single part or quantity production—no job is too big or too small. You can even have your own production line. Taft-Peirce Contract Service is the most complete in the country . . . engineering, design, tooling, model building, development, manufacturing, heat treating, inspection, assembly, shipment. *And costs are unexpectedly reasonable . . . carefully and scientifically controlled.* Whether you need this unique service now or not, it's worth your while to get the full facts on "your plant in Woonsocket" for ready future reference. Write to The Taft-Peirce Mfg. Co., Woonsocket, R. I.

"TAKE IT TO TAFT-PEIRCE"

T P

E. H. Edwards Co., San Francisco, Calif. Patent 2,137,257.

Method of Making a Radiator Ribbon. Stanislaus Przyborowski, Tonawanda, N. Y., assigned to Fedders Mfg. Co., Buffalo, N. Y. Patent 2,137,348.

Manufacture of Bonded and Coated Metallic Articles. Carl E. Swartz, Cleveland Heights, and John E. Wilkey, South Euclid, Ohio, assigned to the Cleveland Graphite Bronze Co., Cleveland, Ohio. Patent 2,137,464.

Manufacture of Resilient Springs. Robert C. Pierce, Niles, Mich., assigned to National Standard Co., Niles, Mich. Patent 2,137,698.

Method of Flame Machining and Welding. Frank C. Geibig, Westfield, and Wilgot J. Jacobsson, Elizabeth, N. J., assigned to Union Carbide & Carbon Corp., New York, N. Y. Patent 2,137,801.

Double Spot Welding. Gerhard Hagedorn, Berlin-Halensee, Germany, assigned to Bernhard Berghaus, Berlin-Lankwitz, Germany. Patent 2,137,909.

Tools and Accessories

Expansible Clamp. Christian D. Ulrich, North Little Rock, Ark. Patent 2,137,315.

Tap. John J. Hebor, Euclid, Ohio, assigned to Niles-Bement-Pond Co., Hartford, Conn. Patent 2,137,340.

Chip Breaker. Robert D. Shaw, Hartford, Conn., assigned to Niles-Bement-Pond Co., Hartford, Conn. Patent 2,137,358.

Continuous Gage. Spencer B. Terry, West Hartford, Conn., assigned to Niles-Bement-Pond Co., Hartford, Conn. Patent 2,137,368.

Grinding Wheel Dresser. Henry W. Kropf, Muskegon Heights, Mich., assigned to Brickner-Kropf Machine Co., Muskegon Heights, Mich. Patent 2,137,690.

Hacksaw. Edward Morris Jack, Torrington, Conn., assigned to Union Hardware Co., Torrington, Conn. Patent 2,137,742.

November 29, 1938

Metal-Working Machinery

Apparatus for Forming Disk Wheels or the Like. Emil A. Nelson, St. Clair Shores, Mich. Patent 2,138,115.

Duplicating Machine. Oscar E. Rosen, Detroit, Mich. Patent 2,138,208.

Crankshaft Grinding Apparatus. Albert J. Sievers, Jr., Oakland, Calif. Patent 2,138,258.

Apparatus for Cutting Metals with Liquid Oxygen. George M. Deming, East Orange, N. J., assigned to Air Reduction Co., New York, N. Y. Patent 2,138,400.

Apparatus for Forming Metal Slugs. Albert H. Gaess, Waterbury, Conn. Patent 2,138,488.

Machine for Grinding and Finishing Cylinders. Kirke W. Connor, Detroit, Mich., assigned to Micromatic Hone Corp., Detroit, Mich. Patent 2,138,535.

Machine for Cutting by Heat Pipes or Similar Objects Angularly Crosswise Thereof. George K. Hull, Fredonia, and Ralph L. Drake, Dunkirk, N. Y., assigned to American Locomotive Co., New York, N. Y. Patent 2,138,676.

Machine for Producing or Finishing Screw Threads by Grinding. Stanley Jaffa Harley, Stivichall, Coventry, England. Patent 2,138,739.

Parts and Mechanisms

Press Slide With Gag Connection. William Klocke, Woodhaven, N. Y. Patent 2,138,106.

Belt Tightener. John J. O'Brien and Miles W. O'Brien, South Bend, Ind., assigned to South Bend Lathe Works, South Bend, Ind. Patent 2,138,117.

Automatic Apparatus for Feeding Strips or Sheets to Presses or Other Machines. Isaac Patrick, Brooklyn, N. Y., assigned to E. W. Bliss Co., Brooklyn, N. Y. Patent 2,138,306.

Checking Mechanism. Ernest Davis, Syracuse, N. Y., assigned to the Prosperity Co., Syracuse, N. Y. Patent 2,138,372.

Clinch Nut. John W. Salter, Kent, Ohio, assigned to the Lamson & Sessions Co., Cleveland, Ohio. Patent 2,138,409.

Roller Aligner. Karl L. Herman, South Bend, Ind., assigned to the Bantam Ball Bearing Co., South Bend, Ind. Patent 2,138,601.

Processes

Propeller Making. John Squires, Hagerstown, Md., assigned to United Aircraft Corp., East Hartford, Conn. Patent 2,138,127.

Method of Making Metal Fittings and the Like. Frans B. Wendel, Long Island City, N. Y. Patent 2,138,199.

Method of Making Propeller Blades. Frank W. Caldwell, Hartford, Conn., assigned to United Aircraft Corp., East Hartford, Conn. Patent 2,138,370.

Tools and Accessories

Material for Initiating a Welding Arc. John D. Crecca and Samuel S. Scott, St. Albans, N. Y. Patent 2,138,025.

Wire Bending and Securing Device. James B. Dempsey, Topeka, Kan., assigned to the Government of the United States. Patent 2,138,026.

Adjustable Clamping Tool. David C. Smith, Toledo, Ohio, assigned to himself and Orville S. Brumback, Toledo, Ohio. Patent 2,138,245.

Tool Holder. Edward J. Lynch, Detroit, Mich. Patent 2,138,253.

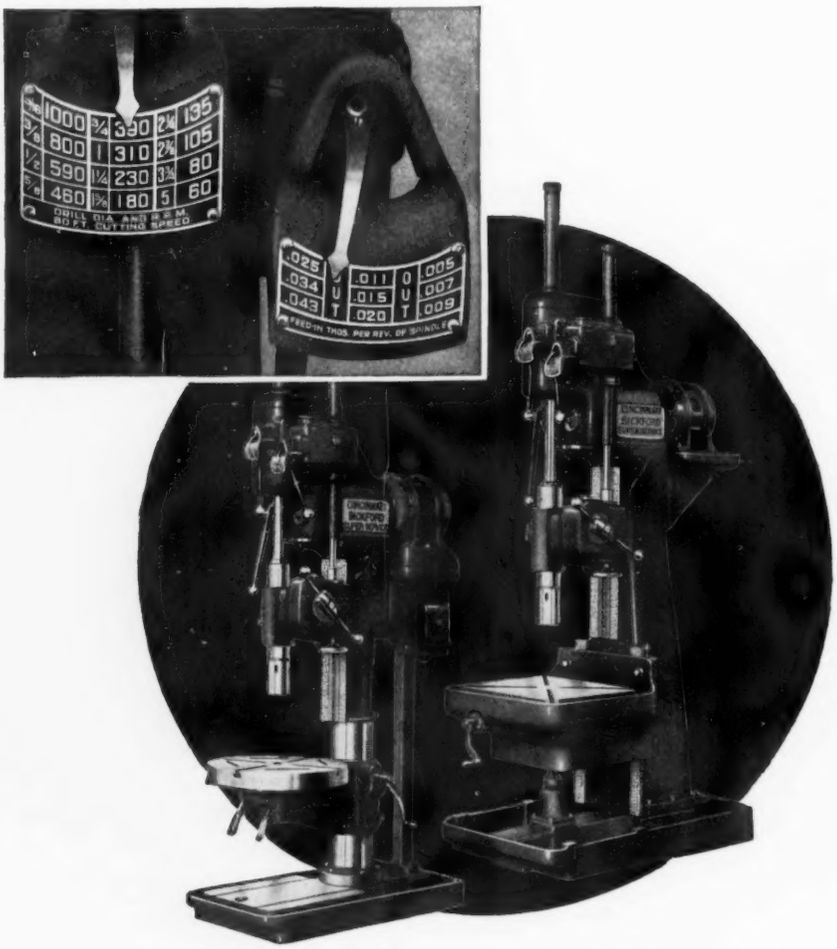
Grinding Tool. Albert J. Sievers, Jr., Oakland, Calif., assigned to Edward W. Oliver, Piedmont, and Phelps E. Gooch, Oakland, Calif. Patent 2,138,257.

Thickness Gage. John P. Brunt, Chicago, and Edward E. Maston, Wilmette, Ill., assigned to Brunt & Co., Chicago, Ill. Patent 2,138,290.

File Rest. Carl Anderson, Westfield, Mass. Patent 2,138,395.

Method of Determining the Surface Characteristics of Workpieces. Hilding Valdemar Töornebohm, Goteborg, Sweden, assigned to Aktiebolaget Svenska, Kullagerfabriken, Goteborg, Sweden. Patent 2,138,411.

Cutting Tool. Stuart A. Cogsdill, Detroit, Mich. Patent 2,138,727.



MORE HOLES PER DOLLAR

from **SUPER SERVICE UPRIGHTS**

21" 24" 28" All Geared

SUPER C.B SERVICE

A wide range of useful drilling speeds and feeds, instantly available by direct reading single lever control, promotes rapid and efficient operation. Write for Bulletin U-22 giving full particulars.

THE CINCINNATI BICKFORD TOOL CO.
OAKLEY CINCINNATI OHIO U.S.A.

Apprentices Have Problems, Too

A. W. FORBES
Forbes & Myers

Gordon W. Richards tells of having discovered that he and the other apprentices were being graded on their work, and not told about it (*AM*—Vol. 82, page 994). He asks why, and I would like to tell some

of the reasons that might have applied to his plant:

1. The employers have seen how the marking systems of schools work, and do not want it. They have seen the efforts made by students to get better marks than the quality of work deserves, and they have seen these efforts succeed to the detriment of scholarship. They may have made an effort to have some of the advantages of grading without this fault.

2. Employers do not generally have much confidence in marks of this kind. They may want them as a guide, but without trusting them. They know some of the eccentricities of some of the foremen who are to make the ratings, and know how to make allowances. But if the apprentice knew he was receiving an unfair mark, there would be dissatisfaction, even though the management knew that it was unfair, too.

3. If there were public marks, the apprentices who received the best marks would feel a right to the better positions in the company at the end of the course. But the company wants to give the jobs to the ones who will best fill them, the ones who have talent for the particular opening when there is a vacancy, and that may be to someone well down on the list of accomplishments in the different work of the apprentice.

4. The boss may be merely trying out some marking system. He may not have in mind using these marks at all for judging the apprentices, but only to find out whether the marking system is a good one. He may want to try four or five systems and then either adopt one publicly or discard them all.

Cost of Welding

Welding costs are reduced by (1) use of larger machines which are more efficient than small ones, (2) by use of large electrodes which deposit metals of high quality and high ductility. This large electrode results in less tendency toward distortion. The use of large generators and large electrodes produces, therefore, welded construction of improved quality and at low cost. And when quality goes up and cost goes down, can more be required of a process?

From a paper presented by E. W. P. Smith, consulting engineer, The Lincoln Electric Co. before the semi-annual meeting of the American Society of Mechanical Engineers.

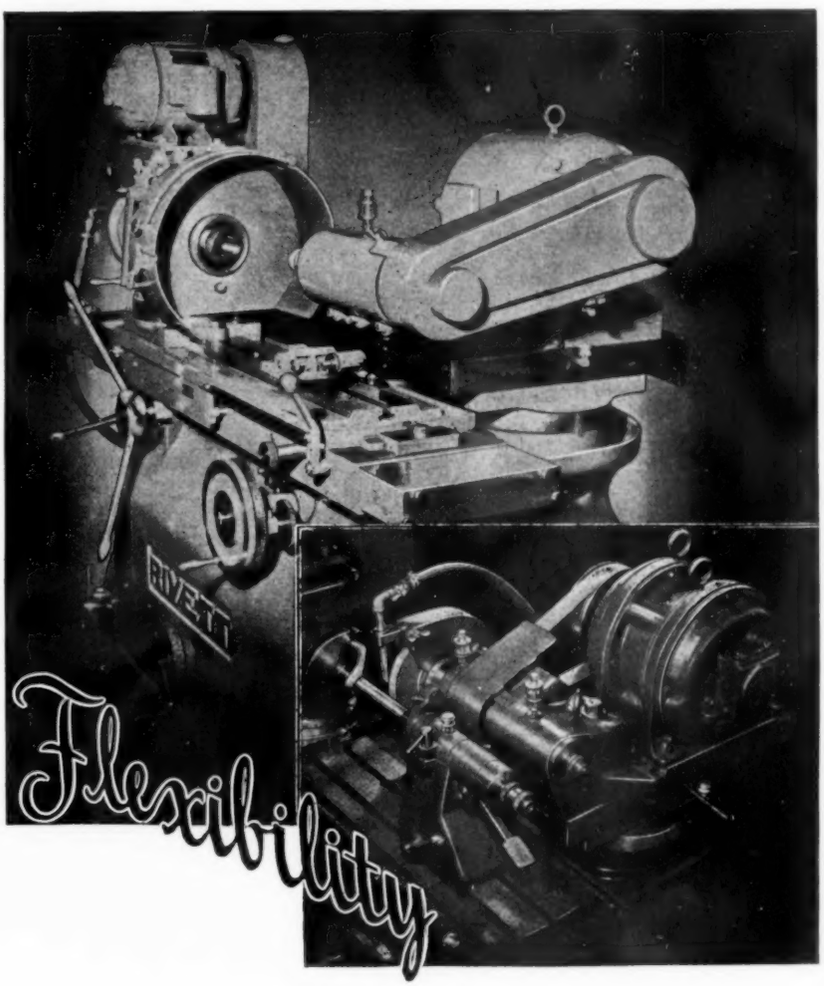
Burned-Out Bearings

FRED MERISH

Burned-out bearings are frequently caused by excessive belt tension between motor and countershaft, and in many factories the department employees are allowed to make adjustments. In the absence of responsibility, they often do a poor job.

One plant superintendent reports a method, which has enabled him to eliminate burned-out bearings, a source of much trouble in the past. For several years now, since this plan has been in operation, he has had but one burned-out bearing in 140 motors.

He places responsibility for adjustments to belt tension upon the plant electrician or maintenance man. The man so designated takes up slack by moving the motor on its rails or base plate. He calls in a millwright, whenever necessary, to shorten the belt. Because responsibility is fixed, the electrician is on guard at all times to see that the belts have the proper tension; otherwise, he will go on the carpet and in addition, have a hard job on his hands repairing burned-out bearings.



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